AMERICAN ENGINEER AND RAILROAD JOURNAL.

OCTOBER, 1899.

CONTENTS.

ILLUSTRATED ARTICLES:	Page	MISCELLANEOUS ARTICLES:	Page
12-Wheel Locomotive—Illinois Central Railroad	315	10-Wheel Freight Locomotives, C. G. W. Railway	321
Principles of Car Trussing	318	Remarkable Passenger Run on New York Central	324
Center of Gravity of Locomotives	319	Personals	328
112,000 Lbs. Steel Car—Caledonian Railway	320	Car Lighting with Acetylene	329
Coke as Locomotive Fuel	322	Case Hardening	329
Pneumatic Blow Off Cocks and Check Valve	324	Port Openings of Locomotive Valves	330
Malleable Iron Draft Gear	332	Feed Water Heaters on Locomotives	330
Locomotive Pilot and Tender Coupler	333	Association to Improve Patent System	332
Electric Power in Blacksmith's Shops	334	Railway Accidents in 1898	333
Axle Lighting	336	New York Central Annual Report	335
Caskey Portable Hydro-Pneumatic Riveter	337	Water for Hot Locomotive Bearings	338
Henrikson Flue Cutter	340	Books and Pamphlets	339
Bullock Street Railway Generator	341	EDITORIALS:	
MISCELLANEOUS ARTICLES:		Westinghouse Brakes in Russia	326
Heat Transmission in Locomotive Boilers	311	Train Resistance Formulas	326
Breakage of Rails in Track	312	Locomotive Testing Plant vs. Road Tests	326
An American Observer Abroad	313	High Pressure and Dry Steam	327
Cornelius Vanderbilt	314	Coke Burning on Locomotives	327
Philadelphia Export Exposition	318		

HEAT TRANSMISSION IN LOCOMOTIVE BOILERS.

Material for Heating Surfaces.

Most Advantageous Lengths of Tubes.

By William Forsyth.

In the construction of the English locomotives recently built in this country, considerable freedom was allowed in the use of American details, and except in their external appearance the engines are in essential points not very different from our own. It is remarkable, therefore, that the English practice of using copper fireboxes and brass tubes has been strictly adhered to, resulting in a material increase in cost with no apparent advantage in efficiency over steel or iron plates and tubes.

Long continued practice and conservatism may be responsible for this, for English locomotive superintendents must be too intelligent to think they are getting a greater evaporative efficiency by the use of copper fire surfaces instead of steel. Without making a special investigation of the subject it is probable that many railroad men would give this as the most obvious explanation.

It may be useful, therefore, to give here some of the fundamental facts relating to heat transmission as applied to locomotive heating surfaces. It is necessary to distinguish between internal conduction and external transmission. The former is the transfer of heat between the particles of one continuous body. It varies with the heat conductivity, which depends upon the nature of the substance and is directly proportional to the difference between the temperatures of the two surfaces of the plate.

If silver be taken as the standard at 1,000, then rolled copper has a heat conductivity value of 845, steel 397 and wrought-iron 436. The internal conductivity of copper is therefore more than twice that of steel, but it must not be assumed, as is often the case, that a copper plate with hot gas on one side and water on the other will transmit twice as much heat to the water in a given time as a steel plate of equal thickness and temperature. For such conditions we have to deal with the external transmission of heat, and the laws governing it have not been exactly determined by experiment.

It is surprising that such important data relating to the physics of heat and that which has such frequent practical application has been the subject of only a few crude experiments. The results of those made on the evaporative action of different portions of the heating surface of steam boilers indicate the general law that the quantity of heat transmitted per degree of temperature is practically uniform for various differences of temperatures. The transmission is accelerated by the mechanical impingement of gaseous products upon the plate. When the surfaces are perfectly clean, the rate of transmission of heat through plates of copper from hot gas to water is somewhat greater than for steel, but when the surfaces are dimmed or coated, as they always are in practice, the rate is the same for the different metals.

Within the limits used for fire surfaces in locomotive boilers the activity of transmission is not affected by the thickness of the plates. The record of tests recently made with two large stationary boilers, exactly alike, except that one had iron tubes and the other copper tubes, showed the evaporative efficiency to be practically the same. An excellent opportunity for a more interesting experiment was presented in these new English locomotives. If one of them had been built with a steel box and iron tubes, and careful measurements made of the evaporative efficiency as compared with a similar boiler with copper firebox and brass tubes, little, if any, difference would have been found, and it would set at rest the false ideas about the superior efficiency of copper. It would have also served a good purpose in determining the relative life and cost of repairs of fireboxes and tubes of such different materials.

The fact that the value of heating surface is independent of the material, and its thickness, is recognized in the revised code for boiler trials, recently reported to the American Society of Mechanical Engineers, where it is required that heating surface be measured on the side next the fire. The Serve tube is a familiar illustration of the fact that the fire side of heating surface is the valuable part which should be increased, and not the water side. If much improvement would have resulted from increased surface on the water side, tubes with ribs on the outside could have been much easier made and kept clean. But such an arrangement has not been seriously proposed.

The relative value of heating surface exposed to radiant fuel, as in a firebox, and that of the tubes which are only exposed to hot gases, has not been determined very accurately and the data relating to it are scanty. In the case of tubes the path of the gases is parallel to the walls of the tube, but in the sides of the firebox they strike the sheets at an angle and the amount of heat transmitted increases with the angle.

Laboratory tests of the efficiency of locomotive tubes under different conditions have already been made at the University of Illinois, as thesis work by a recent graduate. Some of the results obtained are as follows: A loss of 13.8 per cent. was found due to scale having a thickness of 3/32 inch. For heat transmission alone the Serve tube, 2¾ inches outside diameter, was found to be 51 per cent. more efficient than a plain tube of the same outside diameter. The experiments with Serve tubes made on the Paris, Lyons & Mediterranean Railway demonstrates the fact that the same results are obtained with them as with plain tubes of equal diameter but twice the length. This suggested the use of shorter Serve tubes and that railway has found short Serve tubes and the short boilers required for them so advantageous that they now use Serve tubes only 9 or 10 feet long. It is likely, however, that when Serve tubes are introduced in this country it will be for the purpose of getting all the additional efficiency possible, and we do not believe that shorter boilers will be built, but that their size will continue to grow in all directions as it has in the past.

In regard to the ratio of length of tube to outside diameter, the present practice varies from 60 to 80, being as low as 60 on Continental compound express engines; on American express engines it is about 70, on British express engines 75, and on some six-wheel coupled Continental express engines as high as 80. In an extreme case, the Chicago, Burlington & Quincy Atlantic type engines with tubes 16 feet long and 2¼ inches diameter, the ratio is 85. Under similar conditions tubes

of different diameters will have the same efficiency if the ratio of length to diameter is maintained. The reason for this is that the number of molecules of hot gas in contact with the walls of the tube (that is, those which are transferring heat) increases as the circumference of the tube; but the number of molecules passing through the tube increases as the area of the cross-section of the tube. Consequently, in order to give up an equal amount of heat to the water, the length of tube must be increased in proportion to its diameter.

The experiments of Mr. Henry, Chief Engineer of the Paris, Lyons & Mediterranean Railway on the efficiency of tubes of various lengths were made with brass tubes 1⅞ inches outside diameter, with lengths varying from about 10 to 23 feet. The ratio of diameter to length in the case of the 23-foot tube was 122. The experiments were carried on from 1885 to 1890, and the complete report, giving the results obtained, was published in the "Annales des Mines," 1894. A brief extract from this report, giving some of the principal figures bearing on our subject, was published in this paper September, 1899, page 289. They show that with the 10-foot tube the water evaporated per pound of coal was 7.87 pounds, and the smoke box temperature was 739° F. With the 23-foot tube the rate of evaporation was 10.20 pounds and the smoke box temperature 432° F. An increase of 130 per cent. in length of tube increased the evaporation 30 per cent. Within the limits of general practice the figures showing the effect of increasing a tube from 13 feet to 16 feet are more interesting. This increase of 23 per cent in length resulted in an increase in the rate of evaporation of 7 per cent. It should be understood that these data are only applicable to the conditions under which the experiments were made and which were really those of stationary boiler practice and not those under which locomotives are worked. The combustion of coal per square foot of grate per hour with the 10-foot tube was 38.2 pounds, and with the 23-foot tube only 28.9 pounds, which is only about one-fifth the amount burned on American express locomotives. As the quantity of coal burned per hour is increased, so also is the velocity of the gas passing through the tubes increased. With a velocity five times as great as that under which Mr. Henry's experiments were made, results would be obtained far different from those he has reported. While his experiments are considered classic in their way, we do not believe they have any general application in determining the efficiency of long tubes in locomotive boilers.

In the English edition of the "Bulletin of the International Railway Congress" there is a valuable paper on the "Efficiency of Tubes of Locomotive Boilers," by A. Wöhler, in which the author attempts to deduce by mathematics the effect of the velocity of the gas passing through a tube on the efficiency of the tube. For necessary data he has reference to Mr. Henry's experiments. In his discussion Mr. Wöhler explains that the effect of the molecules of gas in contact with the walls of a tube depends on the *velocity of the gas current* as well as its temperature, the period of contact of the molecules varying inversely as the velocity of the gas current. This velocity was calculated from the coal consumption and the mean air consumption given in Mr. Henry's reports, the product of the two giving the total amount of air which would pass through the tubes. The total amount of hot gas may be represented by this, as the difference is small. This divided by the product of the number of seconds and the total cross-section of the tube gives the velocity of the gas current. The interesting theoretical deductions which Wöhler makes from his mathematical treatment of the problem are given in a table which shows the proper ratio of length to diameter of tubes required to obtain different degrees of efficiency when the velocity of the gas currents vary from about 5 feet to 20 feet per second. While the maximum velocities given are much too low for application to modern locomotive practice, they call for tubes having a ratio of length to diameter of 100 where ordinary efficiency is expected, and 130 as a maximum where the velocity of the gas is 20 feet per second. For 10 feet per second and ordinary efficiency, a ratio of 75 is required. The greater the velocity of the gas current the larger should be the ratio of length to diameter, and for the high velocities of gas in tubes of fast express locomotives it appears that it would not be practicable to use a plain tube long enough to obtain the maximum theoretical efficiency. The fact that high speed locomotives should have tubes as long as possible does not seem to be generally recognized, and we have endeavored to show why they are especially necessary for economy, where the velocity of the gas passing through them is so high.

If it is found to be a practicable thing to use tubes 18 to 20 feet long in a locomotive, it will be important to show by careful tests the economic value of each additional foot in length beyond 16 feet. The experiments of Mr. Henry, as we have shown, deal with rates of combustion entirely too low for our present purpose. The theoretical treatment of the subject by Mr. Wöhler points to the necessity of long tubes for high gas velocities. It now remains to show by careful measurements on a locomotive testing plant the value of long tubes when used with high rates of combustion.

The whole subject of heat transmission under conditions found in locomotive boilers is one which would form an interesting series of experiments for an engineering laboratory to undertake, and it is suggested to the enterprising professors who are extending the field of original research in connection with their regular courses of instruction.

The breakage of rails in track appears to be very infrequent, and it is reassuring to read the statements of well-known authorities in England in a recent discussion of the subject before the Institution of Civil Engineers. One said that on the Northeastern Railway, during a period of 25 years, the number of rails broken in the track averaged one in 3,500. Another gave the experience of the London & Northwestern for 12 years, during which time but 388 rails had broken, and yet without causing a single accident. Taking the average life of a rail on this road at 20 years he had found the average rate of breakage to be 1 in 2,000. From particulars given by Mr. Footner, the speaker last referred to, it was seen that "neither the age nor the weight of the rail, nor the amount of traffic, nor the influence of the seasons, nor the position in curves and tangents, nor the action of brakes or trains starting, took any such leading part as to justify the assumption that any of them determined the fractures." The discussion tended to show that the speakers did not see any reason to believe that a worn rail was any more likely to break, except from weakness due to the section having worn down, than a new one. "In this respect," says "Engineering News," in commenting upon the discussion, "we believe that English experience coincides with the American. The increase in weight of rolling stock in this country has been kept pace with by the increase in the weight of rail sections, and so far as our knowledge extends, rail breakages are, if anything, less frequent now than they were 20 years ago."

Superheated steam offers a number of advantages which are summed up by Mr. R. S. Hale in "The Engineering Magazine" as follows: 1st. A slight gain at the boiler, although a less gain than can be obtained by increasing the boiler heating surface, or by the use of an economizer. 2d. A large gain in economy at the engine, while as a disadvantage there is: 3d. An increased loss in the steam pipes, due to increased radiation, fall of pressure and increased leaks. With from 500 to 700 degrees temperature of the steam, Mr. Hale places the results to be obtained as follows:

Gain at boiler	2 per cent.
Gain at engine	10 to 20 per cent.
Extra loss in pipes	4½ per cent.
Net gain	7½ to 17½ per cent.

AN AMERICAN OBSERVER ABROAD.

I.

England.

Professor W. F. M. Goss.

Editor American Engineer and Railroad Journal:

Your suggestion that I write a few letters to home friends for delivery through the columns of the American Engineer has, as you see, proved over-alluring. A reader may so easily dispose of a printed letter—may read it, scan it hastily, pass it over altogether, certainly need never answer it—as to make it clear that I shall lay a burden on no one by writing; at least on no one except the editor, and editors have effectual methods of relief.

To properly understand his English experiences, an American should occasionally pass in review the great procession of his fellow countrymen who have preceded him. By so doing he will the more readily see how it is that he is everywhere recognized as an American, why porters prefer carrying his luggage to that of his English fellow passengers, and why shop keepers in response to his inquiry for wares voluntarily reduce their shilling prices to a dollar basis.

An Englishman whom I met by chance one day in Scotland assured me that "Americans in England can have anything they want," a statement which I, with my capacity for wanting things, was somewhat inclined to doubt. He insisted upon his view, however, and illustrated it by an incident of his own journey. In Edinburgh, a few days before, he had attempted to see Holyrood Palace, but had been met with the statement that the building was closed for repairs. To this he replied that he had travelled a considerable distance for the purpose of seeing the place; that he could not remain in Edinburgh until the repairs were completed, and that he had made his present visit in conformity with the advertised statement concerning the admission of visitors. He urged, therefore, as a special favor, to be shown through the building. To this rather stirring appeal the attendant is reported to have said:

"I am very sorry. If you were an American it could probably be arranged. But it will be quite impossible for an Englishman to be admitted to-day," a statement which he, an English taxpayer, considered interesting and suggestive, but, on the whole, rather discriminating.

Besides what was gained from the fact of being an American, and therefore privileged, I enjoyed many opportunities for which I am indebted to engineering friends at home. Some had given letters of introduction, which, when presented, brought forth a most cordial response. Others had in past years been admirable and well-remembered hosts to English travelers in America, and I had the good fortune to be accepted as a representative of some of these entertainers, and to receive courtesies which I enjoyed as thoroughly as though I had earned them all.

I was impressed by the many complimentary expressions concerning Americans and things American. The manager of a large manufacturing company whom I first met in London, assured me that when I should visit him I should find a shop which probably was more nearly American "than any other in England." Later, when I had seen his works and observed the excellence of their equipment and the completeness of their system of manufacture, I realized with what praise he had spoken.

I did not visit any large establishment that had not some machines of American manufacture. They were always pointed out and their satisfactory performance was generally the subject of comment. In an extensive railway shop where only one American tool was exhibited, the information was volunteered that others were ordered and many more were in prospect.

The American locomotive in England was often discussed. I never introduced the subject, but there were few engineers with whom I had any considerable conversation who did not refer to it. Men associated with railways in mentioning the matter sometimes exhibited circulars of information from agents of American builders and laughingly remarked that it was easy enough to buy locomotives if one chanced to be in need, while outside engineers often talked in a strain which indicated that they looked upon the advent of our locomotives as an epoch marking incident; as the initial step in a process which in some way is to make for the increased convenience and comfort of the English traveling public. To what extent this vision is warranted I am not prepared to say, but it is clear that its existence is a tribute to the energy and skill with which American engineers have wrought. The business significance of the situation is admitted by all. Some say, a few locomotives more or less in England is not a matter of importance, "but how about the control of our colonial and other foreign markets?"

None of the American engines had been put in operation at the time I left England, though I understood that the first shipment was nearly ready for service. I have since heard nothing as to their performance, but I am sure that whatever the official judgment may be, the public acclamation will approve the engines.

Englishmen, however, are not inclined to so exalt American industry as to think lightly of their own, but it is as pleasurable as it is just to emphasize the readiness with which they give expression to their feelings of appreciation. A well-informed gentleman, in speaking of the matter, summarized the situation by saying: "The fact is that the present generation of Englishmen has always been kindly disposed toward Americans, but until your Spanish war gave us a chance to serve you, Americans haven't believed it."

The history of England is well told in the monuments to her great men. Her victories on land and sea, the development of her literature, and her progress in civil liberty are written in bronze and stone memorials all over the land. In remembering her great warriors and statesmen she has not forgotten her engineers. As one travels about he frequently comes upon tributes to Watt and the two Stephensons—men who, though pioneers, have left an impress so clear that a century of progress has left it unobscured.

One sees here many traces of an earlier engineering practice. It is wonderful how by repeated repairing, or by occasional modification in form to meet the requirements of a changed external condition, an old machine or an old design may be made to render service. A locomotive built forty years ago was pointed out with evident pride as "still working regularly in fast express passenger service." The usual form of freight car brake now in use is substantially the same with that operated by George Stephenson when, as a boy, he rode colliery cars down an incline. The present gear, however, is of iron and acts upon all four wheels of the car, while the brake of Stephenson's day was of wood and acted upon a single wheel only. The present arrangement consists of a rocker shaft located underneath the center of the car and extending across its full breadth. This carries four short arms, each of which connects with a brake-head acting upon one of the wheels of the car; and attached to one end is a long arm or handle extending along the length of the car nearly to the end, by means of which power is applied. In release the handle is hooked in a position nearly horizontal; for service application it is unhooked and allowed to drop, its weight being sufficient to produce the desired brake shoe pressure; and for emergency the attendant follows up a service application by standing on the handle. The brake is serviceable for yard work only, the attendant running beside the car except during an emergency application, and except when the cars are switched too fast for him, in which case the braking is entirely omitted. The light weight of the cars and the excellent character of the buffers with which they are fitted make the braking of cars of much less consequence than in American service.

W. F. M. GOSS.

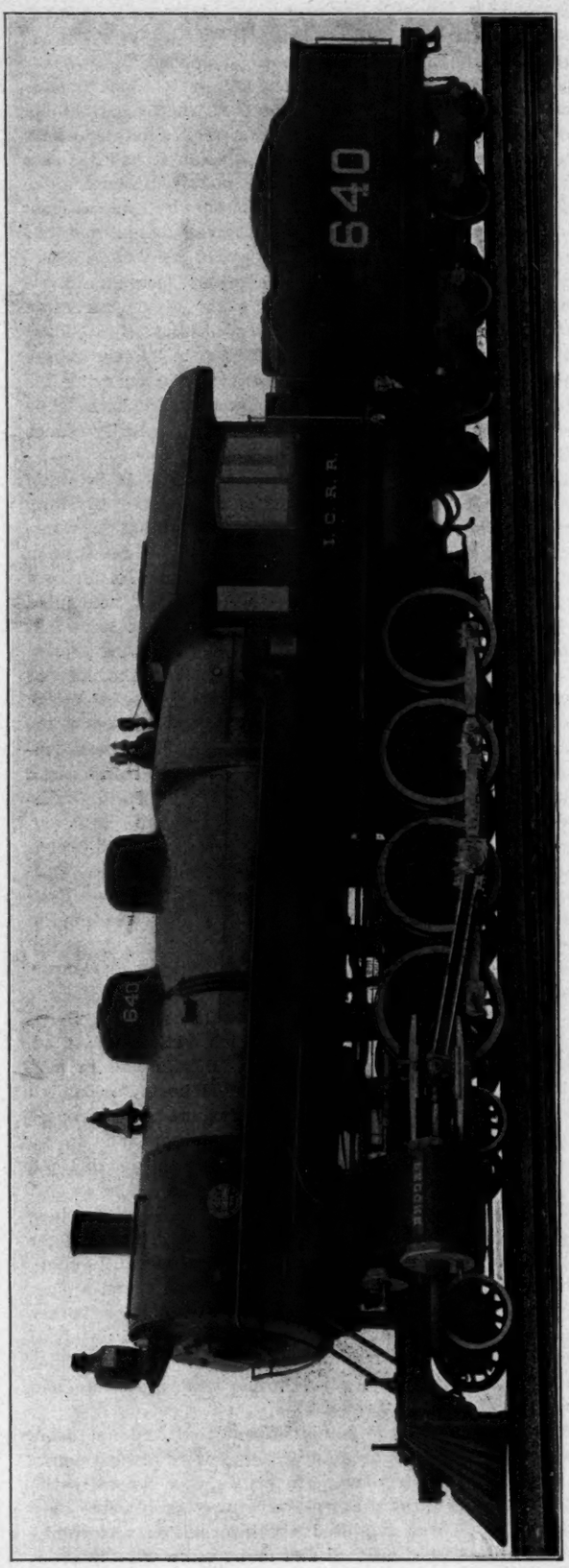
Dresden, August 30, 1899.

CORNELIUS VANDERBILT.

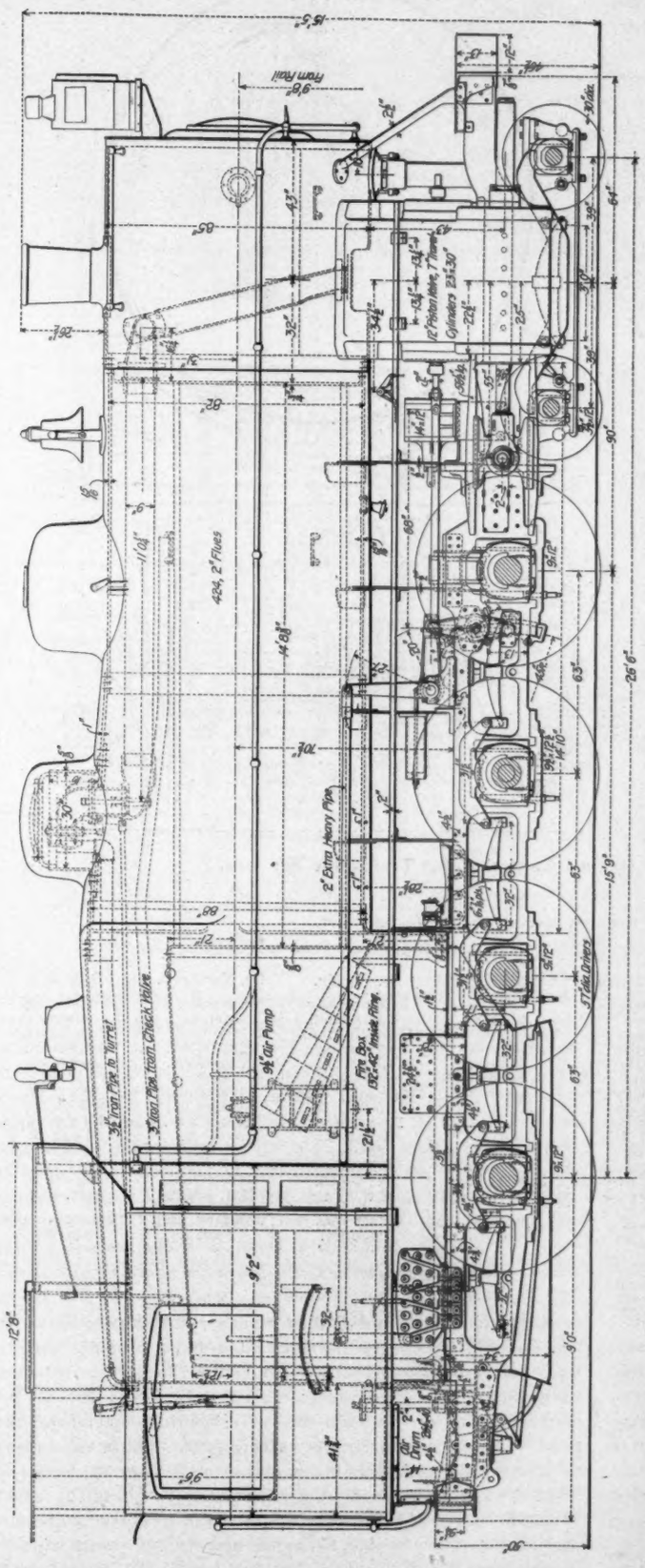
Cornelius Vanderbilt died at his home in New York, Tuesday, Sept. 12th, from a stroke of paralysis. He was the head of the Vanderbilt family and until about three years ago was in active charge of the enormous Vanderbilt railroad interests. At that time he suffered from a paralytic shock. The daily papers have given such complete details of Mr. Vanderbilt's career as to render it unnecessary to repeat them here. It is sufficient to say that he inherited a vast estate, which he doubled in value, and that in the height of his activity he held important offices in about 45 different railroads. Mr. Vanderbilt was born at New Dorp, Staten Island, in 1843. He was the eldest son of Wm. H. Vanderbilt and grandson of Cornelius Vanderbilt, who laid the foundation for these famous properties. In spite of the exacting nature of his self-imposed work in increasing the value of the fortunes left him, Mr. Vanderbilt found time from the business hours of every day to give to the welfare of others. The New York Central and other Vanderbilt lines have profited, and will continue to profit for years to come, by his generous support and active interest in establishing wholesome surroundings for the men when off duty in connection with the railroad branch of the Young Men's Christian Association. The very fine building near the Grand Central Station, New York, which he built and equipped for the use of the employees of the New York Central Railroad, will be an enduring memorial of his generosity. He was a thorough believer in the idea of surrounding the employees with good influences inspired by Christian motives. The religious side of Mr. Vanderbilt's life was an important one and there is no doubt that a great many worthy objects received financial support from him in a quiet way.

Rails 60 feet long have several theoretical advantages over shorter ones, among which is the saving in the number of joints necessary to instal and maintain. At the recent convention of the Roadmasters' Association the discussion seemed to indicate that the practical objections to their use are serious, and it is certain that the use of long rails is not increasing. Roads having put in experimental sections of 60-foot rails are not placing further orders for long ones. The chief difficulties are: 1st, the long rails are hard to handle; 2d, they are not properly straightened at the mills; 3d, they require large openings between their ends to allow for expansion in the track; and, 4th, they require much more labor to keep the track in good condition as to surface. Rails 33 feet long were more favorably considered. They afford a reduction of 10 per cent. in the number of joints and are not much more difficult to handle than those of the usual length of 30 feet. The committee reporting on the subject recommended a length of 33 feet.

The punching of rivet holes in boiler sheets is usually condemned as unsafe unless the distressed material immediately around the hole is removed by reaming. Mr. T. R. Browne, Master Mechanic of the Pennsylvania Railroad at the Juniata shops in Altoona, in discussing the construction of boilers before the New York Railroad Club, recently, directed attention to an important matter concerning the use of punched sheets, which is not probably well understood. Mr. Browne said: "Where the practice of punching sheets flat is followed, the hole should be punched from that side of the sheet which will be on the outside of the curve when the sheet is rolled; in other words, that portion of the sheet which is on the inside of the curve when it is rolled should be next to the female die. We have known side sheets to be very seriously cracked through the rivet holes owing to the fact that the holes were punched in such a way that the fin side of the hole came on the outside of the curve and the strain on the fin, or thin edge of the hole, was sufficient to start the crack. Where it is not possible to punch the holes in this way without extra handling, these fins should be removed before the sheet is punched."



TWELVE-WHEEL FREIGHT LOCOMOTIVE—ILLINOIS CENTRAL R. R.



TWELVE-WHEEL FREIGHT LOCOMOTIVE—ILLINOIS CENTRAL RAILROAD.
The Heaviest Locomotive Ever Built.

BROOKS LOCOMOTIVE WORKS, *Builders.*

W. RENSHAW, *Superintendent of Motive Power.*
W. H. V. ROSING, *Mechanical Engineer.*

This Locomotive was Designed to Haul a Train Weighing 2,045 Tons up a 38-Foot Grade, with Curves of 3 Degrees, at 15 Miles per Hour.

12-WHEEL FREIGHT LOCOMOTIVE.

Illinois Central Railroad.

Built by the Brooks Locomotive Works.

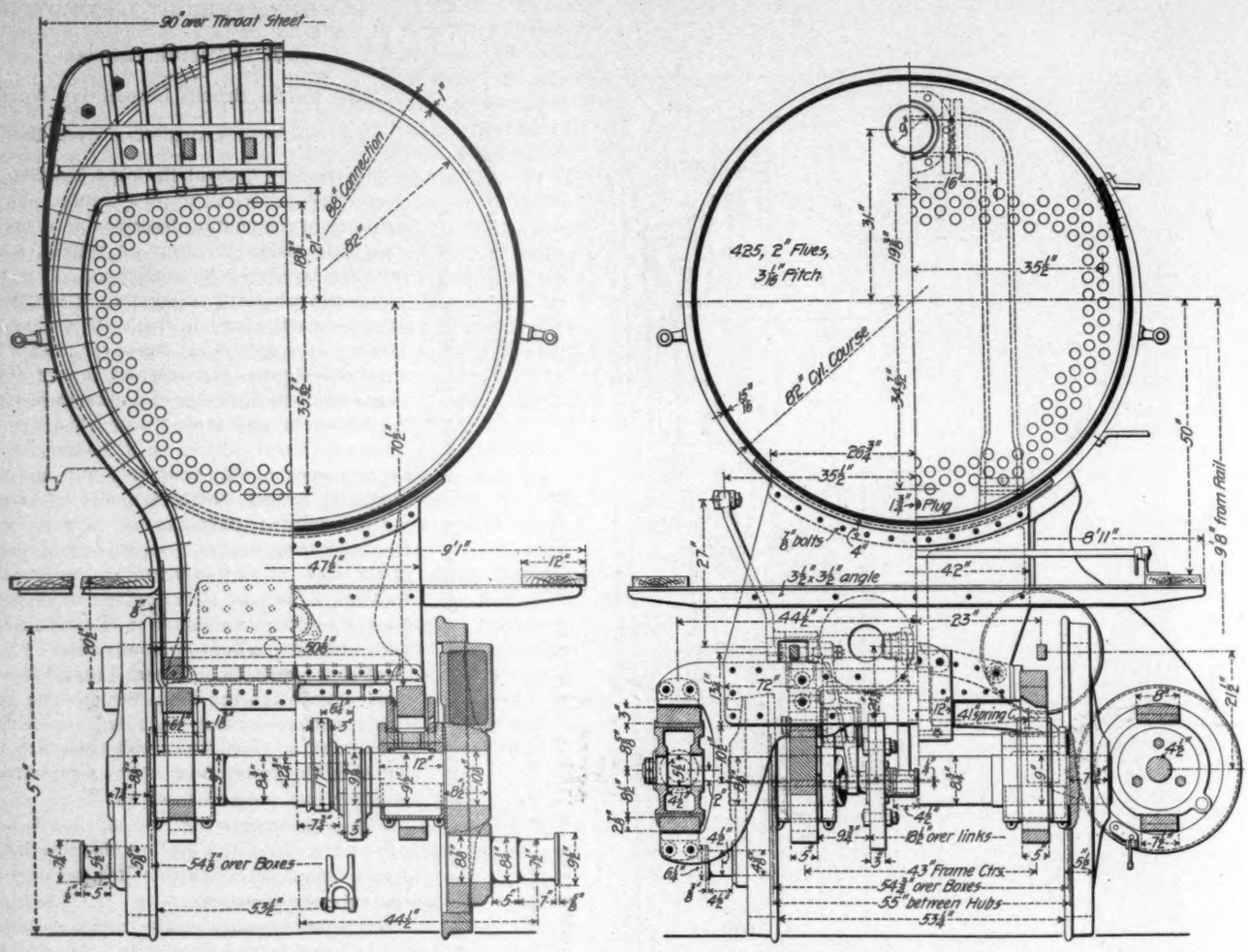
The Heaviest Locomotive Ever Built.

The Illinois Central Railroad has now the record locomotive as to total weight, and the builders of the engine, described here, believe that this marks the limit of weight, which will not be passed for some time. It is bold to predict what the locomotive of the future is to be, particularly in regard to weight and power. It is safe to say, however, that if the limit of weight is now reached, that of power is not and will not be until a number of fruitful resources, now almost untouched, are exhausted. Great weight is, of course, necessary in securing high tractive power, and that designing is best which furnishes the greatest amount of train-hauling capacity with the least total weight. An interesting view of the ideas of various roads and locomotive builders as to how to attain the most satisfactory results is presented in the table herewith, which contains a comparison of the chief characteristics of recent heavy locomotives. In comparing these designs the special conditions which each is intended to meet must be considered, and these are included in the descriptions of the locomotives, as far as it is possible to do so.

It may be interesting to have attention called to some of the leading characteristics of this design, although they are included in the table of dimensions.

The boiler pressure of 210 pounds calls for a strong boiler and unusually thick sheets. The thickness of the barrel plates is 15/16 and 1 inch, the back tube sheet is ¾ inch, the crown is 7/16 inch, the front tube sheet ⅝ inch, and the side and back firebox sheets are ⅜ inch. The mud ring is 4 inches wide at the back and front and 3½ inches at the sides, the water spaces at the top being 5 inches at the back, 7½ inches at the sides and 4 inches at the front. The diameter of the boiler at the front end is 82 inches and at the throat 91¼ inches, the boiler being of the Player belpaire wagon top form, with sextuple lap horizontal seams and triple lap circumferential seams. The firebox is 132 by 42 inches inside the mud ring, and the grate area is 37½ square feet. There are 424 two-inch tubes 14 ft. 8⅜ in. long over the flue sheets. The tube heating surface is 3,237 square feet, and with the exception of the Baldwin compounds for the Lehigh Valley (American Engineer, December, 1898, page 395), this is the largest number of tubes of which we have record. The brick arch is supported on studs. The front end arrangement includes Mr. J. Snowden Bell's spark arrester.

The driving wheels are of cast steel and 57 inches in diameter; they have flanges throughout. The cylinders are 23 by 30 inches; they are of the same diameter as those of the Union Railway locomotive (issue of November, 1898, page 365), and 2 inches shorter stroke. The piston rods are extended. The



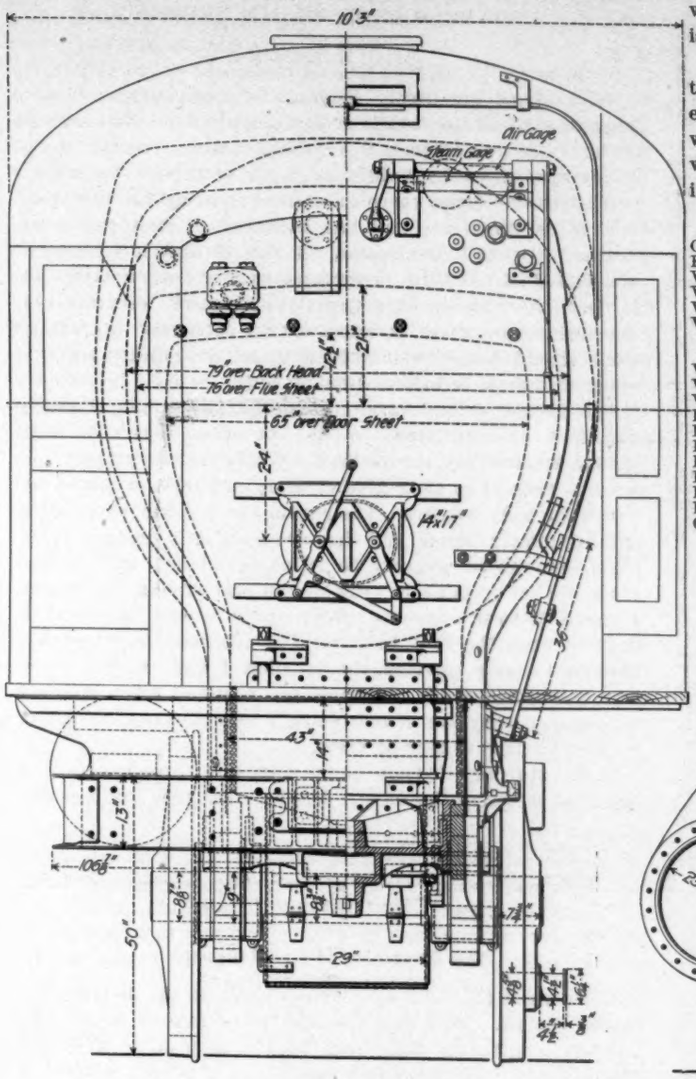
Twelve-Wheel Freight Locomotive—Illinois Central R. R.—Transverse Sections.

Leading Characteristics of the Heaviest Modern Freight Locomotives.

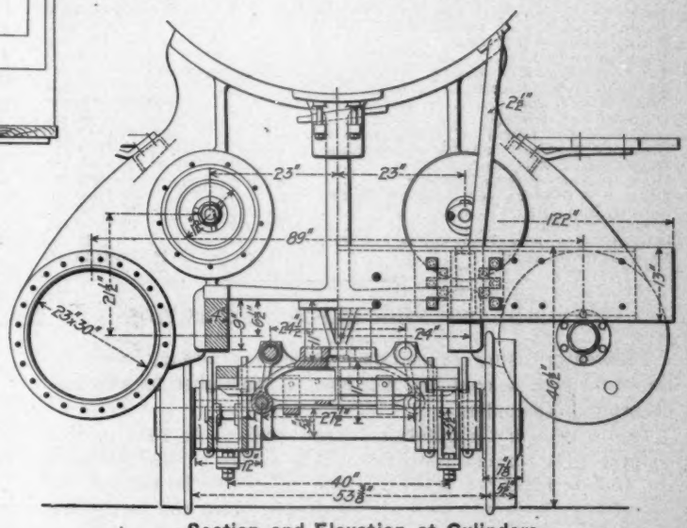
Railroad	Union.	Lehigh Valley.	Illinois Central.	Pennsylvania Class H5.	So. Pacific.	Gt. Northern.	B. & M. R.
Builder	Pittsburgh.	Baldwin.	Brooks.	P. R. R.	Schenectady.	Brooks.	Pittsburgh.
Simple or compound	Simple.	Vauclain Comp'd.	Simple.	Simple.	Compound.	Simple.	Simple.
Type	Consolidation.	Consolidation.	12-Wheel.	Consolidation.	Consolidation.	12-Wheel.	Consolidation.
Total weight	230,000 lbs.	225 082 lbs.	232,200 lbs.	198,0 0 lbs	193,000 lbs.	212,750 lbs.	181,200 lbs.
Weight on drivers	208,000 lbs.	202,232 lbs.	193,200 lbs.	176,000 lbs	173,000 lbs.	172,000 lbs.	166,000 lbs.
Size of drivers	54 in	55 in.	57 in.	56 in.	57 in.	55 in.	52 in.
Size of cylinders	23 x 32 in.	18 and 20 by 30 in.	23 x 30 in.	23½ x 28 in.	23 and 35 by 34 in.	21 x 34 in.	22 x 28 in.
Heating surface	3,322 sq. ft.	4,103.6 sq. ft.	3,500 sq. ft.	2,721 sq. ft.	3,027.8 sq. ft.	3,280 sq. ft.	2,675 sq. ft.
Firebox size	120 x 40⅛ in.	120 x 108 in.	132 x 42 in.	120 x 40 in.	126 x 40⅝ in.	124 x 40⅛ in.	114 x 40 in.
Grate area	33.5 sq. ft.	90 sq. ft.	37 5 sq. ft.	33.3 sq. ft.	35.3 sq. ft.	34 sq. ft.	31 6 sq. ft.
Steam pressure	200 lbs.	200 lbs.	210 lbs.	185 lbs.	220 lbs.	210 lbs.	180 lbs.
Size of boiler	80 in.	80 in.	82 in.	71 in.	72 in.	78 in.	74 in.
Tubes, number and size	355—2¼ in.	511—2 in.	424—2 in.	306—2¼ in.	332—2¼ in.	376—2¼ in.	292—2¼ in.
Tubes, length	15 ft.	14 ft. 7¾ in.	14 ft. 8⅜ in.	14 ft.	14 ft. 6 in.	13 ft. 10⅜ in.	14 ft. 6½ in.
Description in American Engineer and Railroad Journal	November, 1898. Page 365.	December, 1898. Page 395.	This issue.	June, 1899. Page 177.	May, 1899. Page 150.	January, 1898. Page 1.	September, 1898. Page 296.

valves are of the piston type, 12 inches in diameter, with 7 inches stroke and the arrangement of the packing rings is new in locomotive practice in connection with valves of this type, although it has been in general use in marine practice. The packing rings are about 3 inches wide and made in a single piece, which is split, forming a joint for the reception of a shim, the thickness of which may be increased to compensate for the wear of the valve bushing. The ring is closed against the shim by a bolt passing through lugs cast on the inside of the ring. When thus secured, the ring can not be enlarged by internal pressure of steam, and this arrangement appears likely to overcome the difficulties which have been experienced with piston valve packing rings, because it avoids the necessity for securing tight fits of the rings where they are held by the followers, and it does not matter whether steam gets under the rings or not. Of course the rings must make close fits with the bushings in order to prevent leakage, and the adjustment made by means of the shims must be accurately done. It will, possibly, be necessary to ream the valve bushings after they have been placed in position in the valve casing. Piston valves seem to be specially desirable, if not absolutely necessary, with such large cylinders and such high pressures. To guess the weight of piston valves of this size it would be put at about 200 pounds, and a slide valve would be much heavier for steam ports 28 inches long.

The arrangement of the valves, the frames and equalizers may be seen in the engravings. The front sections of the frames are in the form of single bars 4 by 9 inches in section, with an



Rear Elevation and Section.



Section and Elevation at Cylinders.

would be imposed by brake hangers that would pull down, as is the case when the shoes are placed in front of the drivers.

The tender has a capacity of 7,000 gallons of water and 12 tons of coal, yet it does not look large when coupled to such an enormous locomotive. It is carried on Fox pressed steel trucks with double elliptic springs and 5 by 9 inch axles. The weight of the tender loaded is 132,700 lbs. The following table gives a summary of the important dimensions:

General Dimensions.

Gauge	4 ft. 8½ in.
Kind of fuel to be used	Bituminous coal
Weight on drivers	193,200 lbs.
Weight on trucks	39,000 lbs.
Weight, total	232,200 lbs.
Weight, tender, loaded	132,700 lbs.

General Dimensions.

Wheel base, total, of engine	26 ft. 6 in.
Wheel base, driving	15 ft. 9 in.
Wheel base, total, engine and tender	55 ft. 2¾ in.
Length over all, engine	42 ft. ⅜ in.
Length over all, total, engine and tender	65 ft. 7⅝ in.
Height, center of boiler above rails	9 ft. 8 in.
Height of stack above rails	15 ft. 5 in.
Heating surface, firebox	263 sq. ft.
Heating surface, tubes	3,237 sq. ft.
Heating surface, total	3,500 sq. ft.
Grate area	37.5 sq. ft.

upward bend toward the bumpers. Lateral bracing is provided between the frames at the forward drivers, at the front of the firebox and at the back ends. The depth of the upper bar of the double bar frame varies; it is 5 inches between the first and second pairs of drivers, 4½ inches between the second and fourth and 4¾ at the rear of the fourth pair up to the rear expansion pad, where it takes the slab form, which continues to the back end. The frames are 5 inches wide. The boiler is supported at four points betwen the cylinders and the firebox by braces of ½-inch plate, three of which also support the running boards, which are flush with the cab floor.

The main driving axles and crank pins have enlarged wheel fits, as will be seen in the transverse sectional views of the engine. This practice is to be commended and it is hoped that in future designs the other driving axles will receive the same treatment, especially in view of the fact that there appear to be no objections to such an enlargement. The driving journals are 9 by 12 inches, except the main pair, which are 9½ by 12 inches. The section through the guides shows them to be large, the upper bar is 8 to 3 inches, and the lower one 7½ by 2⅞ inches. This view also clearly shows the directness of the valve connections between the links and the valve stems. The rocker arms are both inside the frames. The brake cylinder is placed back of the saddle, and the brake shoes are placed back of the driving wheels, which causes the hangers to push upward against the frames when the brakes are applied; this prevents the serious addition to the load on the springs, which

Wheels and Journals.

Drivers, diameter	57 in.
Drivers, material of centers	Cast steel
Truck wheels, diameter	30 in.
Journals, driving axle, main	9½ in. by 12 in.
Journals, driving axle, others	9 in. by 12 in.
Journals, truck	5½ in. by 12 in.
Wheel fit, main	10½ in. by 8½ in.
Main crank pin, size	7½ in. by 7 in.
Main coupling pin, size	8¼ in. by 5 in.
Main pin, diameter wheel fit	8⅞ in.

Cylinders.

Cylinders, diameter	23 in.
Cylinders, stroke	30 in.
Piston rod, diameter	4½ in.
Kind of piston rod packing	Jerome
Main rod, length center to center	98 in.
Steam ports, length	28 in.
Steam ports, width	2½ in.
Exhaust ports, least area	110 sq. in.
Bridge, width	3½ in.

Valves.

Valves, kind of	Improved piston
Valves, greatest travel	7 in.
Valves, steam lap (inside)	1⅛ in.
Valves, exhaust lap or clearance (outside)	Line and line
Lead in full gear	1/16 in. negative
Lead, constant or variable	Variable

Boiler.

Boiler, type of	Player belpaire wagon top
Boiler, working steam pressure	210 lbs.
Boiler, material in barrel	Steel
Boiler, thickness of material in barrel	15/16 in. and 1 in.
Boiler, thickness of tube sheet	⅝ in.
Boiler, diameter of barrel, front	82 in.
Boiler, diameter of barrel at throat	91¼ in.
Seams, kind of horizontal	Sextuple, lap
Seams, kind of circumferential	Triple, lap
Crown sheet, stayed with	Direct stays
Dome, diameter	30 in.

Firebox.	
Firebox, type	Long, over frames
Firebox, length	132 in.
Firebox, width	42 in.
Firebox, depth, front	90 in.
Firebox, depth, back	81½ in.
Firebox, material	Steel
Firebox, thickness of sheets	Crown, 7/16 in.; tube, ⅝ in.; side and back, ⅜ in.
Firebox, brick arch	On studs
Firebox, mud ring, width	Back, 4 in.; sides, 3½ in.; front, 4 in.
Firebox, water space at top	Back, 5 in.; sides, 7½ in.; front, 4 in.
Grates, kind of	Cast iron rocking
Tubes, number of	424
Tubes, material	Charcoal iron
Tubes, outside diameter	2 in.
Tubes, thickness	No. 12 B. W. G.
Tubes, length over tube sheets	14 ft. 8⅜ in.
Smokebox.	
Smokebox, diameter outside	85 in.
Smokebox, length from flue sheet	75 in.
Other Parts.	
Exhaust nozzle, single or double	Single
Exhaust nozzle, variable or permanent	Permanent
Exhaust nozzle, diameter	5⅞ in.; 6⅛ in.
Exhaust nozzle, distance or tip below center of boiler	7 in.
Netting, wire or plate	Wire
Netting, size of mesh or perforation	2½ in. by 2½ in. and 2½ in. by 1¼ in.
Stack, straight or taper	Steel, taper
Stack, least diameter	15¼ in.
Stack, greatest diameter	17¾ in.
Stack, height above smokebox	26½ in.
Tender.	
Type	8-wheeled
Tank, capacity for water	7,000 gal.
Tank, capacity for coal	12 tons
Tank, material	Steel
Tank, thickness of sheets	¼ in.
Type of under frame	Oak
Type of springs	Double elliptic
Diameter of wheels	33 in.
Diameter and length of journals	5 in. by 9 in.
Distance between centers of journals	5 ft. 3 in.
Diameter of wheel fit on axle	6⅝ in.
Diameter of center of axle	5⅜ in.
Length of tender over bumper beams	24 ft. 0 in.
Length of tank	22 ft. 0 in.
Width of tank	10 ft. 0 in.
Height of tank, not including collar	72 in.
Type of draw gear	M. C. B. Thurmond

THE PHILADELPHIA EXPORT EXPOSITION.

This enterprising exposition, which has already been referred to in these columns, was opened September 14, with appropriate ceremonies.

This is the first exhibition of the kind to be held in this country. Its purpose is to spread knowledge of our mechanical and agricultural industries and products throughout the markets of the world with a view of extending and increasing our exports. During the last few years these have been increasing enormously and a much greater development is expected from a better understanding on the part of the outside world of our facilities and resources. In short, the exposition is intended to create a demand for American products, and one of the notable features will be an industrial congress, to which representatives of foreign trade organizations have been invited. We are informed that more than a thousand of these delegates have already accepted and a great deal is expected from the information and impressions they will receive.

The exposition is arranged on a large scale with three central buildings, the chief of which covers more than 12 acres of space, while the others are not as large. This enterprise promises to be very important and useful. It is well located and we believe that the exposition opens with no debt on the buildings.

While the primary object is to give foreigners a proper conception of the advantages of buying goods in this country, another important part of the project is that which serves to instruct our manufacturers in what they very much need to know of the foreigners' requirements, not the least important of these being in methods of packing and shipping goods for the satisfaction of the consignees and the customs authorities.

Steel ties have not been satisfactory on the New York Central. "Engineering News" states that the experimental section at Garrisons, N. Y., laid with Hartford's steel ties ten years ago, has given a great deal of trouble in getting out of line and also out of surface. The ties have proved durable, but they are expensive in maintenance of track. They also increase the noise of trains in passing over them on account of the rattling of the stone ballast and the bolts.

THE PRINCIPLES OF CAR TRUSSING.

By O. H. Reynolds.

With all of the timely suggestions made with a view to improvement in the details of car construction, there appears to have been no attempt to establish definite practice in the location of cross-tie timbers or depth of trusses for similar conditions—at least, there is nothing bearing on this question in car literature that has happened to come to our attention. Possibly the reason for this is that the matter is considered of too little importance to merit much attention; in fact, the absence of systematic treatment warrants that conclusion, for there is quite enough diversity in practice (that should follow well defined lines) to indicate either a want of interest or information, or both.

The degree of importance attached to the points of design named is best explained by the statement that sills, even though trussed, are in the best condition to carry their load when supported so as to give three equal panels or spaces between the body bolsters. The reason for this is obvious, since sills are simply beams, and they are frequently made to carry loads that cannot properly be called distributed, and in such cases the car framing is weak at the part having the longest distance between supports. With three equally spaced divisions between the body bolsters, it is necessary to proportion the sills to carry, unaided, the distributed load between cross-ties, and also between cross-ties and bolsters; when sills are so designed they are strong enough to withstand all other stresses brought to bear on them.

In the proposed division of the sills into three panels it is seen that the cross-ties have a definitely assigned location and

The Principles of Car Trussing.

distance apart that is always proportioned to the distance between bolsters. With this distance for a base it is an easy problem to give the truss rods such a drop as to keep the fiber stress within the requirements, and it is this matter of depth of truss that is vital after the location of cross-ties has been decided on. This is illustrated by the accompanying stress diagram of a 60,000 pound car—which is shown without the superstructure, as that has no bearing on the subject in hand.

This car is 36 feet long, and has six sills, and four 1⅜ inch truss rods. The weight of the body is 18,000 pounds, and with the rated capacity, the load to be carried by the bolsters is 78,000 pounds, or 2,166 pounds per foot. The load supported at the several points is shown above the sills, together with the amounts coming directly on the bolsters, and also those transmitted to the bolsters by truss rods. In this arrangement we find a fiber stress of 13,000 pounds per square inch on each truss rod; there is a pull of 19,000 pounds to produce this stress, and there is also a horizontal component due to this pull equal to 18,785 pounds on each rod, which must be provided for at the end sill.

The effect of an unsymmetrical disposition of the cross-ties by making them 6 feet 8 inches between centers, with all other conditions remaining the same, is to put a fiber stress of 14,417 pounds per square inch on each rod, and increase the pull to 21,414 pounds, with a resulting compression of 20,938 pounds on the end sill under each rod. The fiber stress is thus increased nearly 1,500 pounds, due to the movement of the truss rod support one foot nearer the center of the car. There are two remedies to choose from to reduce this fiber stress—one is to make a deeper truss, and the other is to increase the diameter of the rods; if the latter is done, it will require 1½ inch rods, which will reduce the stress to 12,160 pounds per

square inch, with a corresponding reduction of the stress at the end sill. This is a procedure often followed, but it is fallacious, as will be shown.

Returning to the diagram, and leaving all dimensions as they stand, except the depth of truss, and making that 30 inches instead of 24 inches, it can be shown that 1¼-inch rods may be used, which will give a fiber stress of 12,800 pounds per square inch and a horizontal component of only 15,000 pounds. It is evident that increasing the truss is a more advantageous method of reducing the fiber stress than to increase the size of the rod, but there are still other advantages in the increased truss, one of which is the weight of the 1¼-inch rods of 616 pounds per car against 724 pounds for the 1⅜ rods, which is an item worth considering, and the other advantage is the price, which will be, roughly, $18 for the set of 1¼-inch rods and $29 per set for the 1⅜-inch rods. The deep truss also opens the way to a deep section for the cross-tie timbers, which is an important advantage in holding a frame in line transversely to offset weak sills or bad loading, and more particularly the latter.

CENTER OF GRAVITY OF LOCOMOTIVES.—SIMPLE METHOD OF DETERMINING.

By G. R. Henderson,

Assistant Superintendent of Motive Power C. & N. W. Ry.

The determination of the center of gravity of locomotives is a laborious task when computed mathematically, because in order to be accurate the weight and location of the center of gravity of each and every piece should be ascertained and their moments above the rail figured out, but the labor being so great, assumptions are made which affect more or less the final figures. It occurred to the writer that a practical method could be applied and the following was therefore evolved:

Suppose that we have a body of symmetrical cross section, the weight of which is known. If this body be tipped slightly so that one of the edges upon which it stands is lower than the other, the center of gravity will be displaced laterally. If this body rests upon supports at the two lower edges only, then the lower support will sustain more weight than the higher one, due to the lateral displacement of the center of gravity,

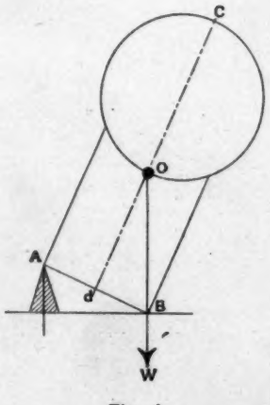


Fig. 1.

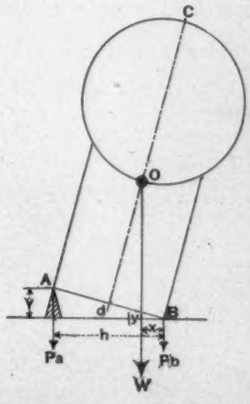


Fig. 2.

and if the angle is such that the center of gravity be vertically over the lower edge, the total weight will come on this edge, and the body will be in unstable equilibrium. Thus, in Fig. 1, the whole weight will come upon the support B, but in Fig. 2 a portion will rest upon A and another portion upon B, but the sum of these two will be equal to the total weight. Let the weight of a symmetrical body be represented by W, the load on each support by Pa and Pb, respectively; then Pa plus Pb equals W. Let also the horizontal distance between the supports be represented by h and the vertical difference by v; also the distance measured horizontally between the support, B, and a vertical dropped through the center of gravity be represented by x. Now, by equal moments Pa × h equals W X, and X equals

$$\frac{Pa\ h}{W}.$$

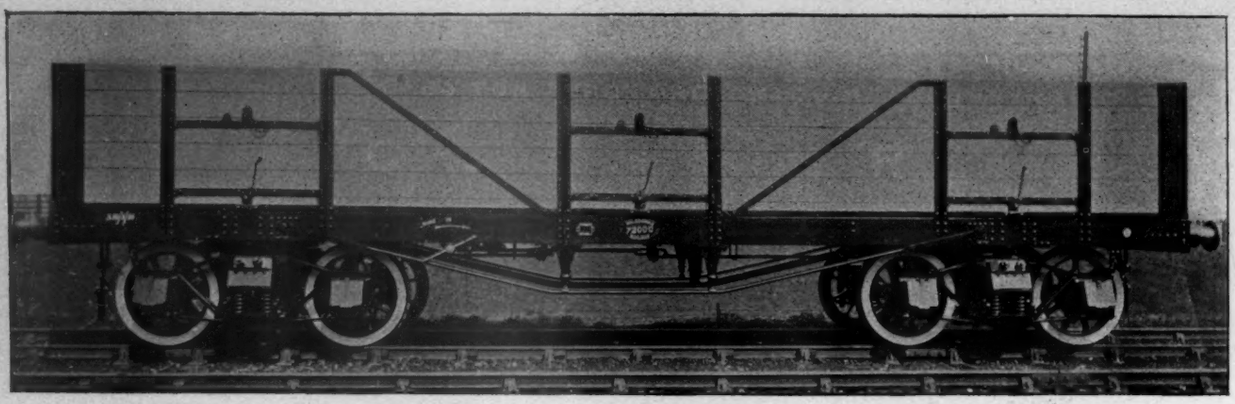
As the body is symmetrical, the center of gravity must be in the central axis c-d and at the intersection with the vertical through y, at a distance X from B, or at O. This may be laid off graphically or it may be calculated by similar triangles.

The reproduced photograph, Fig. 3, illustrates the application of this principle to locomotives. The engine was first carefully weighed on the track scales, with a certain height of water, etc., and was backed off the scales. The rail was then removed from the narrow side of the scale platform, and blocks laid close together, like ties from the outer frame to the fixed or dead rail support, care being taken to see that the portion of the scale under these blocks was entirely free. A rail was laid to gauge on these blocks, and a slope prepared at one end. All was now ready, and the beam being balanced, the water was brought to the same level as before in the boiler, and the engine run upon the new track, and the load upon the lower

Fig. 3.—Easy Way to Locate the Height of the Center of Gravity of a Locomotive.

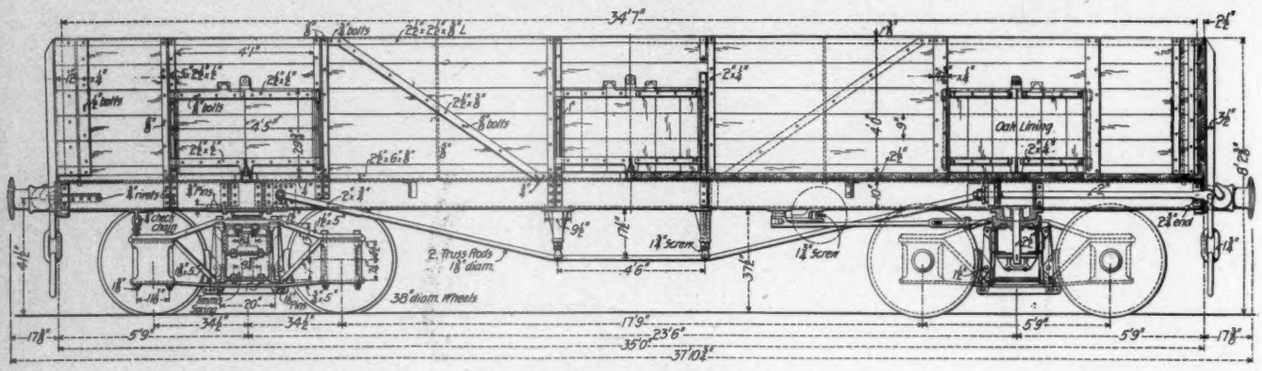
rail weighed. While the engine is upon the scales, a level should be run from rail to rail to determine the exact difference of level for use in making the calculations; in the case illustrated this was about 7½ inches. Of course, there is a slight error, due to shifting of the water sidewise in the boiler, which tends to exaggerate the result. The frames should be blocked over the boxes, so that the boiler will stand relatively to the wheels the same as on level track.

If care be taken, accurate results may be obtained, as with the small elevation mentioned, an increase in weight of 25,000 pounds on the lower side of the engine was shown by the scales, the total weight of the locomotive being about 140,000 pounds.

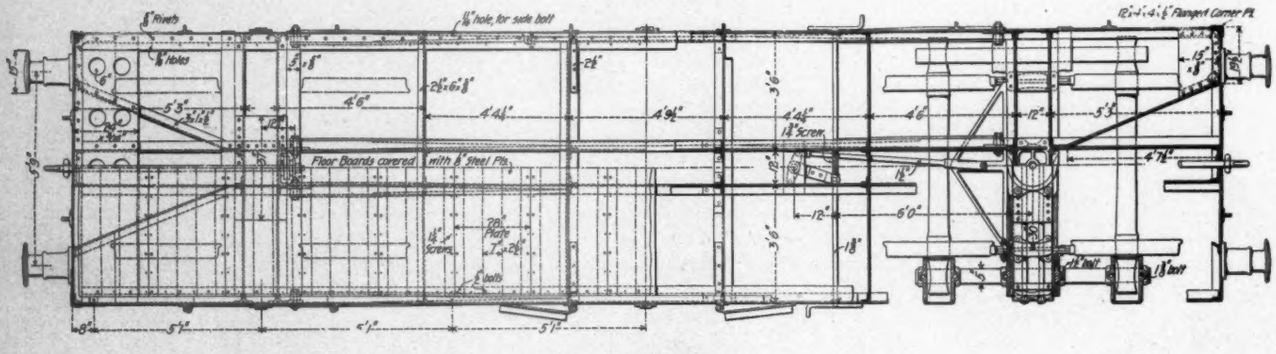


112,000-Pound Steel Ore Car—Caledonian Railway.

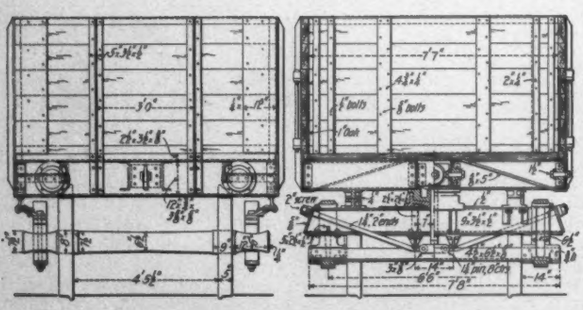
MR. JOHN F MCINTOSH, *Locomotive Superintendent.*



Longitudinal Sections.



Plan and Section.



End View and Transverse Section.

112,000-POUND STEEL ORE CARS IN SCOTLAND.

Caledonian Railway.

A departure in car construction in English practice is marked by the introduction of 50-ton (English tons of 2,240 lbs.) gondola cars of the American type upon the Caledonian Railway. Through the courtesy of Mr. John F. McIntosh, Locomotive Superintendent of the road, we have received a photograph of one of these cars, together with particulars and drawings.

These cars have steel underframes and wooden sides built on framing of steel and they are mounted on two four-wheel trucks, of the American type, with arch bar side frames. The design is by Mr. McIntosh, and the cars were built at the St. Rollox Works of the road.

The cars have four sills, which are 10 in. channels with plate end sills and frequent transverse stiffening plates, which, together with the corner braces, are clearly shown in the engravings. There are eight truss rods of 1⅜ in. iron terminating at

the bolsters and placed close together at each side of the longitudinal sills. The body bolsters are 10 in. channels and the truck bolsters are of the same section, 9 in. high and trussed with two 1¾ in. rods.

The journals are concave and 6 and 7½ by 12 inches in size. We are not told the weight beyond the fact that they have only half the tare of ordinary English "wagons," although accommodating seven times the load of iron ore which the small ones will carry. Twenty of these cars take the cargo of a vessel carrying 1,000 tons of ore, and English traffic men are greatly interested in the experiment which promises great acceleration in the despatch and economy of handling such cargoes. The principal dimensions are as follows:

Capacity	50 tons iron ore
Total wheel base	29 feet 3 inches
Wheel base of truck	5 feet 9 inches
Length over headstocks	35 feet
Length over buffers	38 feet 4 inches
Length inside body	34 feet 7 inches
Width inside body	7 feet 7 inches
Depth of body	4 feet
Journals (concave)	12 inches by 6 and 7½ inches

Mr. McIntosh says that were it not for the narrow limits of clearance he would build the cars from 18 inches to two feet wider, and he would also make them higher. He also writes that this design is not confined to the ore traffic, but is also carrying grain, cement and steel billets. It is likely to be used in hauling coal for the locomotives of the road. The couplings are of the ordinary British type, and judging from experience with heavy cars in this country, it may be expected that they will need to be modified perhaps on the lines of our practice. The cars have Westinghouse brakes. They are also fitted with a simple device for applying the hand brakes from either side of the car, which was recently brought out by Mr. McIntosh. It is stated that the use of these cars in general service will necessitate many alterations along the line in the sidings and turntables, and that these changes will be made if the experiment proves to be successful. To us there is no doubt of the success of the car itself, the only question being as to the possibility of getting them over English roads with their restricted clearances. If successful in this regard, this experiment will probably lead to the introduction of large freight cars, carried on trucks, with automatic couplers and continuous brakes to replace the 8 and 10-ton cars of the present equipment. The innovation is interesting in view of the success of the large car in the United States.

A new design of 6-coupled freight locomotives has been brought out simultaneously with these cars, and specially intended to haul them. These locomotives, also built by the road at St. Rollox, are considered in Great Britain as specially powerful, particularly in boiler capacity. Their chief dimensions are as follows:

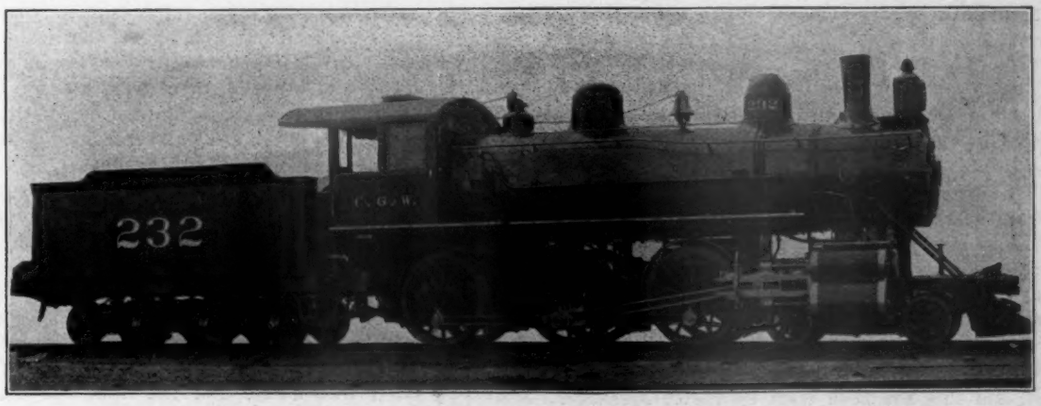
Cylinders	18½ in. dia. x 26 in. stroke
Wheels	5 ft. 0 in. dia.
Heating surface	1,440 sq. ft.
Working pressure	160 lbs. per sq. in.
Wheel base, engine	16 ft. 9 in.
Wheel base, total engine and tender	38 ft. 7½ in.
Tractive force	17,800 lbs.
Tank capacity	3,080 gal.
Weight of engine	102,370 lbs.
Weight of tender	84,900 lbs.
Total weight of engine and tender	187,260 lbs.
Fuel space for 4½ tons of coal.	

It is evident that Mr. McIntosh deserves a great deal of credit for the boldness with which he has treated the car design, and it is the more merited because he builds large cars without the advantage of the transition which characterized the movement in this country.

TEN-WHEEL FREIGHT LOCOMOTIVES.

Chicago Great Western Railway.

This road has ten locomotives like the one shown in the accompanying engraving, built by the Baldwin Locomotive Works, five of which are simple and the other five are Vauclain compounds. These engines have been running since last spring, and, while they are all giving good results, the compounds appear to show an advantage in fuel economy, but the length of service has not been sufficient to permit of determining exactly what the saving will be. We have received the photograph and information from Mr. David Van Alstine, Master Mechanic of the road. The engines have driving axles of "Coffin Toughened Steel," McIntosh blow-off cocks, Westinghouse air brakes, Tower couplers and Leach sanders. The principal dimensions are given in the following table:



Ten-Wheel Freight Locomotive—Chicago Great Western Railway.
Built by the Baldwin Locomotive Works.

Total weight of engine	160,000 lbs.
Weight on drivers	120,000 lbs.
Driving wheel base	15 ft.
Total wheel base of engine	27 ft. 2 in.
Diameter of cylinders, simples	20 in.
Diameter of cylinders, compounds	15½ in. and 26 in.
Stroke of piston	28 in.
Diameter of driving wheels	63 in.
Material of driving wheel centers	Cast steel
Flange tires on all driving wheels.	
Driving box material	Cast steel
Diameter and length of driving axle journals	9 in. by 12 in.
Diameter and length of main crank pin journals	6¾ in. by 6 in.
Engine truck, swing bolster.	
Engine truck journals	6 in. by 12 in.
Engine truck wheels	30 in.
Boiler, style	Wagon top
Diameter at first ring	64 in.
Working pressure	200 lbs.
Firebox	112 in. by 42 in.
Number of tubes	275
Diameter of tubes	2¼ in.
Length of tubes	15 ft.
Heating surface, firebox	190 sq. ft.
Flues	2,410 sq. ft.
Total	2,600 sq. ft.
Grate area	32.6 sq. ft.
Brick arch, supported on 3 in. tubes.	

Tender.

Tender wheels	33 in. cast iron
Journals	4½ in. by 8 in.
Wheel base	15 ft. 4 in.
Tender frame	10 in. steel channel
Water capacity	6,000 gal.
Coal capacity	10 tons
Trucks furnished by Standard Car Truck Company.	

COKE AS LOCOMOTIVE FUEL.

Boston & Maine Railroad.

The Boston & Maine has taken up the subject of coke as a fuel for locomotives in a systematic, practical way, and now has 100 locomotives fitted up for burning it exclusively. The favorable qualities of coke for this service have been known for a long time and its use is not by any means new, but we believe that it has never been adopted so extensively and so successfully before. Not the least interesting feature of the practice is the fact that the coke is obtained at a point far removed from the coal regions.

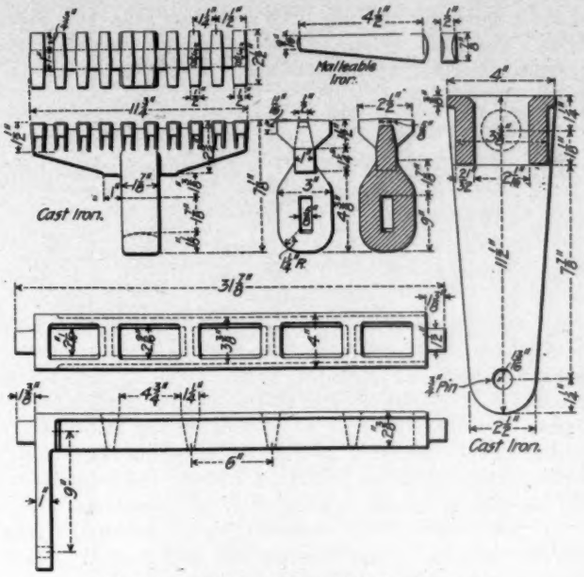
The introduction of the practice on the Boston & Maine was due to the interest which the president, Mr. Lucius Tuttle, takes in the subject of fuel, and its complete success is due to careful application and experiment on the part of the officers of the motive power department. Mr. Tuttle states positively to us that coke burning is an unqualified success and is no longer in any essential feature an experiment. He regards the coke which he is using as an ideal locomotive fuel and engines are being equipped to burn it as fast as possible. The present supply is at the rate of 100,000 tons per year, which is equal to about one-fifth of the amount which would be required for all the locomotives now in service. They would all burn coke if the supply was sufficient. On this subject more will be said later. Mr. Tuttle regards the use of coke as the best solution of the smoke, cinder, dirt and spark problems, and in fire claims alone he expects to save $100,000 a year. He was led into its use by his experience on the New York, New Haven & Hartford because of the rigid smoke nuisance laws of the City of New York. When he was vice-president of that road he experimented with coke and used the Connellsville product for firing a number of locomotives out of New York, the experience being entirely successful as regards the fuel, but the cost was prohibitive for regular road service. Three years ago it was decided that the Boston & Maine was ready to use coke extensively as soon as the question of cost could be satisfactorily disposed of, and this has been done by the co-operation of Mr. Henry M. Whitney and the New England Gas & Coke Co. This company's plant at Everett, Mass., was designed to make gas from Dominion coal and the coke is one of the by-products. If the coke was obtained from coal without regard to other products the cost would be prohibitive, but the plan of these works is such that it is furnished at a cost which is more favorable to the road than that of coal, and while no elaborate comparative tests have yet been made between the two fuels, there is good reason to believe that in evaporative efficiency coke has an advantage. The exact cost is not divulged, but it may be stated positively that it is no more expensive than coal.

About 12 locomotives in suburban service were fitted up for coke burning in April of this year, and at present it is used in this service out of Boston, in switching service on nearly all of the important divisions and in some of the heaviest passenger service of the road between Boston and Portland. In every case it has been entirely successful, whether in short or long runs, and while used chiefly on passenger locomotives there is every reason to expect equally good results in freight work. Sixty of the engines on the Eastern and Western Divisions use it exclusively and the other 40 coke-burning engines are distributed over the other divisions. Its chief advantages are cleanliness and freedom from smoke and from spark throwing. In operation on the road there is a noticeable pale blue haze to be seen from the stack when the engine is working hard with the lever "in the corner," but after shortening the cut-off it is not to be seen except in tunnels or under bridges. The front ends are almost entirely clear but the nettings are not removed because of the possibility of drawing small pieces of fuel through the tubes when working hard. Some clinker forms, but not as much as is found with Dominion coal burned without coking, and most of the coke clinker must be combustible, because it is very seldom necessary to remove it from the fireboxes even after a run of over 100 miles. It is easier to handle than coal, but its bulk is to that of coal as 5 to 3, and large racks are placed on the tenders of engines making long runs. It is the cleanest of solid locomotive fuels. A representative of this journal enjoyed a clean and comfortable ride of about 60 miles on one of these engines. There was no dust or dirt in the cab and none from the stack except a very fine whitish metallic dust which did not adhere to clothing and was not sufficient to be in the least disagreeable. It is evident that the running gear, valve motion and driving boxes will be greatly benefited by the absence of flying dust and grit from the coal. Mr. Tuttle has good reasons for considering it an ideal locomotive fuel.

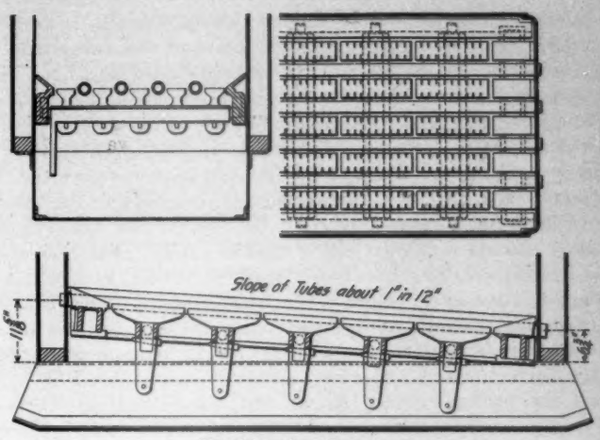
At first it was considered necessary to use water grates because of the extremely high temperature of the fire which resulted in burning out ordinary cast-iron grates. The grates used in the earlier experiments had water bars like those for burning anthracite, and while these did not prove troublesome in any way it was considered desirable to avoid the troubles which time would be likely to develop by the burning out of the tubes. It was considered desirable to save the expense of fitting up the water grates and also to provide means for using exactly the same grates for coke as for coal. Experiment developed the fact that coke may be burned on ordinary cast-iron grates by introducing steam into the ash pans. This cools the grates and prevents them from melting by the intense heat; it also tends to reduce the amount of clinker. The present practice is to place a T in the exhaust pipe from the Westinghouse air brake pump and conduct a portion of the exhaust into a ¾-inch pipe which extends down and across the front end of the ash pan. The end of the pipe is plugged and the steam issues from five ¼-inch holes in this pipe and passes back under the grates. This steam does not appear to have any noticeable effect on the fire, but it is possible that it aids combustion as well as saves the grates. The engines are now converted into coke burners by the addition of this very simple piping and the use of a portion of this steam that would otherwise be thrown away. For the return to coal burning this pipe may be plugged or it may be provided with a cock. A part of the air pump exhaust is sufficient for the coke and only that portion is required that will naturally pass out of a pipe fitted up in this way, while the remainder goes up the stack. The water grates, steam jet piping and the cast-iron grates used in connection with coke are illustrated by these engravings. The cast-iron grate is not new, but is shown because it is successful in burning coke.

The evaporative performance is not yet known, but the regular performance sheets show a uniformly better record for coke than for coal, ton for ton. The advantage in severe passenger service is about one mile per ton. The records of this road are not given in ton-mile units. A part of the saving is in the reduction of back pressure which is due to the possibility of opening out the nozzles. Mr. Henry Bartlett, Superintendent of Motive Power, says that the nozzles of nearly all of the coke burning engines are made about ¼ inch larger than when using coal. This is a very important item because it affects the power of the engine as well as the fuel performance, and if the records were made on a tonnage basis this ought to make a still more favorable showing for coke. When working hard there is some movement of light stuff in the fire but it does not get to the tubes and the tubes are not seriously coated. The coating is easily scraped off at the end of a run and the tubes do not require cleaning out as often as with coal.

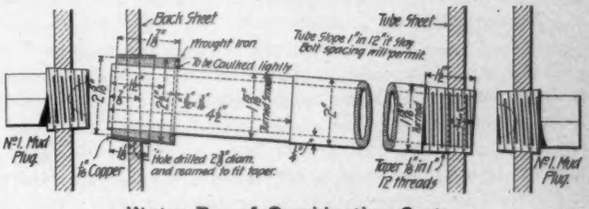
In steaming qualities very little if anything is left to be desired. Coke gives a remarkably hot fire and, thus far, there has been no indication of trouble with tube sheets or tubes. The fact that the fire door is not required to be wide open about half the time should favor these parts and herein is another advantage of coke. The practice is to fill up the firebox to within 3 inches of the door opening, working the



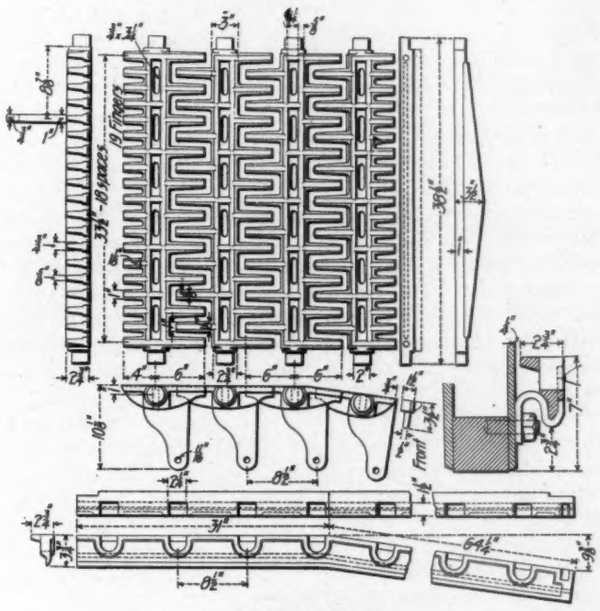
Cast Iron Parts of Combination Grate.
Experimental Form.



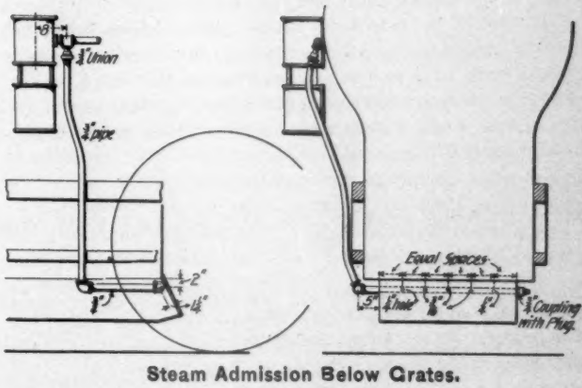
Combination Grate.
Experimental Form.


Back Sheet
Tube Sheet
Wrought Iron
To be Caulked lightly
No. 1 Mud Plug.
Hole drilled 2⅜" diam. and reamed to fit taper.
Taper ⅝" in 1" 12 threads
No. 1 Mud Plug.

Water Bar of Combination Grate.
Experimental Form.



Cast Iron Grate.
Final Form.



Steam Admission Below Grates.
Final Form.

COKE BURNING ON LOCOMOTIVES—BOSTON & MAINE R. R.

Water Grates and Cast Iron Grates Now Successfully Used.

fire somewhat thinner toward the front end. This is done when possible, while at a station or when the engine is shut off, because coke, like anthracite, requires a little time to kindle, and when started it will hold the steam for a hard run of from 6 to 10 miles without touching the fire. The writer saw the run from Lynn to Boston, 11 miles, made with 10 cars in about 15 minutes without the fire being disturbed in any way. The firebox is filled up about 5 minutes before leaving a terminal and the fire is good for about 10 miles. One engineer goes so far as to say that he can fire with coke exactly the same as with coal. The fire door may be kept closed, but it is generally left slightly open. This seems to improve the combustion. It also prevents the coating of the flues and appears to aid in burning up the clinker, although the introduction of the steam jet under the grates has practically overcome the difficulties with clinker. The flame is long and the motive power officers believe that in spite of the high temperature there will be less destructive effect on the firebox sheets and tubes than is experienced with coal. From some engines a large amount of gas escapes into the cab while standing unless the blower is put on, but in other cases the blower is seldom used. The gas is very much like that from charcoal. In running it appears to be necessary to work the grates a little about every six or eight miles. When this is done and steam is admitted under the grates no clinkers are formed except such as may be disposed of without giving trouble.

In looking for some disadvantages about this fuel only one was found. Coke burns so freely that it cannot be banked, and it is necessary to rake the forward portion of the grates bare while standing in the round house. The watchmen give idle engines a little more attention when using coke, but this is not a serious matter. It is, of course, possible that further difficulties may appear with longer experiences. This brief acquaintance seems to be almost too favorable.

The manufacture of the coke is as interesting as its behavior in the firebox. It is made in Otto-Hoffman by-product coke

ovens, of which the New England Gas & Coke Co. has 150 in operation. The immense 288-acre plant of this concern in Everett, Mass., near Boston, will ultimately include 1,200 ovens and 400 are now ready for heating when the necessary provisions for using the gas are completed. This process reduces the cost of gas to such a point as to make it profitable for the gas companies of Boston to discontinue manufacturing, and mains are now under construction connecting the Everett works with the gas holders of the Boston gas concerns, who will become retail dealers of this by-product gas. The usual method of making coke is in "bee-hive" ovens, from which the gas is allowed to escape into the atmosphere. The Otto-Hoffman oven permits of saving not only the gas, but also tar and ammonia, and the coke is stated by the manufacturers to be in some respects superior to that from the bee-hive ovens. It is stated to be chemically equivalent to Connellsville coke and at the same time is denser and physically stronger and also is superior in available heat units by about 4 to 8 per cent. It contains very little iron and sulphur. The slack (½-inch size) of the Dominion coal is used for coking, the lump coal being otherwise disposed of. All these items and particularly the labor-saving appliances which have been worked out minutely at these works, also the great size of the plant, contribute toward reducing the cost of the coke.

The demand for coke in industrial establishments is likely to increase and the New England railroads may not for some time be able to secure as much as they desire. One road has already contracted to take 400,000 tons per year, when that amount is available, and other roads are experimenting with it for their own information, with a view of taking it up after the manner of the Boston & Maine. Inquiries are now being made as to the result, and we shall probably have further information on this subject.

Coke requires care in storage to protect it from the weather, because of its spongy character, and its tendency to absorb water. It should be stored in sheds. Much more information might be included in this description, but further space will be taken only to give the composition of this coke, which is as follows: Volatile matter, 1.27%; fixed carbon and sulphur, 69.82%; ash, 8.91%; moisture, 3.67%. These proportions, of course, vary with the coal.

A REMARKABLE PASSENGER RUN ON THE NEW YORK CENTRAL.

One of the new Schenectady ten-wheel passenger locomotives on the New York Central, illustrated and described in our issue of August, 1899, page 255, hauled an exceedingly heavy train over this road from New York to Albany on August 19th, which is believed to eclipse the records of previous heavy passenger trains. The train consisted of 16 cars, and, excluding the engine, passengers and baggage, weighed 707 tons. Its total length was 1,202 feet. The total weight of the 16 cars, empty, was 1,415,895 pounds. The weight of the mail (estimated) was 30,000 pounds, the baggage 15,000 pounds, the express matter 16,000 pounds, and the estimated weight of 600 passengers is 90,000 pounds, giving a total of 1,837,795 pounds, or 918 tons of 2,000 pounds, including the engine. The individual weight of the cars are as follows: First mail car, 82,775 pounds; second mail car, 87,250 pounds; coach, 86,160 pounds; coach, 93,100 pounds; smoking car, 46,700 pounds; coach, 64,360 pounds; coach, 64,850 pounds; cafe car, 100,000 pounds; dining car, 102,000 pounds; sleeper, 98,600 pounds; sleeper, 102,000 pounds; parlor car, 100,800 pounds; sleeper, 104,500 pounds; sleeper, 103,800 pounds; parlor car, 79,000 pounds; parlor car, 100,000 pounds.

The train made better than schedule time from New York to Albany, 143 miles. The schedule is three hours and fifteen minutes, including two stops, the required speed being 44 miles per hour. The running time of this train was three hours and thirteen minutes, including the two stops, which made a speed for the trip of a little less than 44½ miles an hour. The total weight of the engine and tender is 270,900 pounds. The weight on drivers is 128,900 pounds and on the truck 40,000 pounds.

COMBINED PNEUMATIC BLOW-OFF COCK AND BOILER CHECK.

Wm. McIntosh,
Superintendent of Motive Power, Central R. R. of New Jersey.

A new combination of boiler check valve and a blow-off cock, which really assembles four functions in one device, has been designed and patented by Mr. Wm. McIntosh, Superintendent of Motive Power of the Central Railroad of New Jersey, the device and its attachment to the boiler of a locomotive being illustrated by the accompanying engraving. This arrangement embodies two check valves and a blow-off cock in one fitting, which is also used in connection with conduits inside the boiler, whereby water blown off may be drawn from the surface or from the bottom of the boiler, as desired.

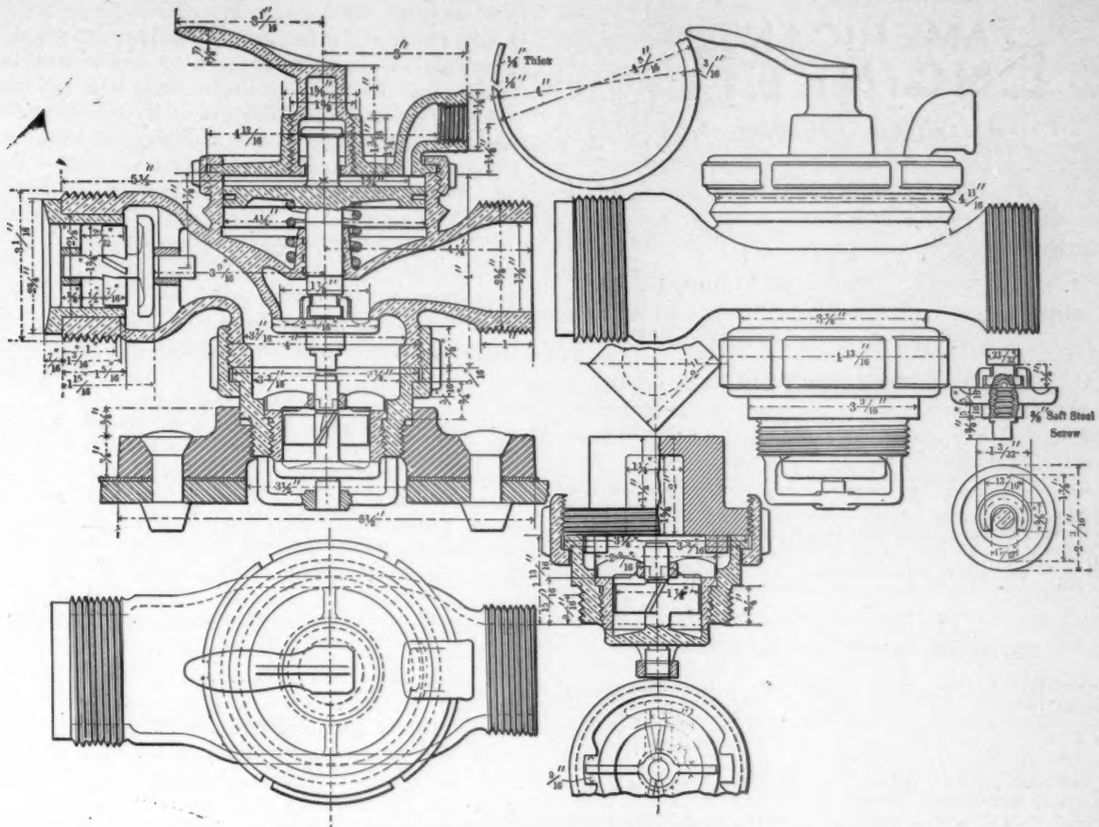
The device combining the check valve and the blow-off cock is attached to the boiler in the usual way by means of a flange secured to the shell of the boiler by rivets. Into this flange the casing containing the valves is screwed and the check valve nearest the boiler is almost entirely within the flange itself, the only projection beyond the face of the flange being the end of the spindle where it passes through its guide. The attachment of the valve casing to the flange is reinforced by an annular extension of the flange into which the cylindrical portion of the casing fits, forming a substantial reinforcement to guard against the breakage of the casing at this point. The casing also contains an outer check valve, a blow-off cock and an air cylinder for the operation of the blow-off cock. The neck of the casing immediately below the blow-off cock is thinned down to make this point weaker than any other part, for the purpose of inviting fracture, due to any outside injury, at a point away from the main check valve, as a measure of safety.

The construction of the device is very clearly indicated in the engraving. The valves are guided and are not dependent upon wings to keep them in position. The check valves have wings arranged with spiral inclinations for the purpose of twirling the valves while in use, which tends to keep them free from obstruction. These wings are located at a sufficient distance from the face of the valve to give a full opening for the entrance of the water.

The blow-off cock requires little explanation, except to state that it is operated from the cab by air pressure, which is applied against the piston in the cylinder, the valve being brought to its seat by the spiral spring when there is no pressure upon the boiler. The purpose of the handle at the top of the valve is to provide means for opening and closing the blow-off cock by hand and its operation is made clear by the drawing. The air piston opens the blow-off valve and by pressing against the spindle of the inner check valve the boiler water is allowed to pass out.

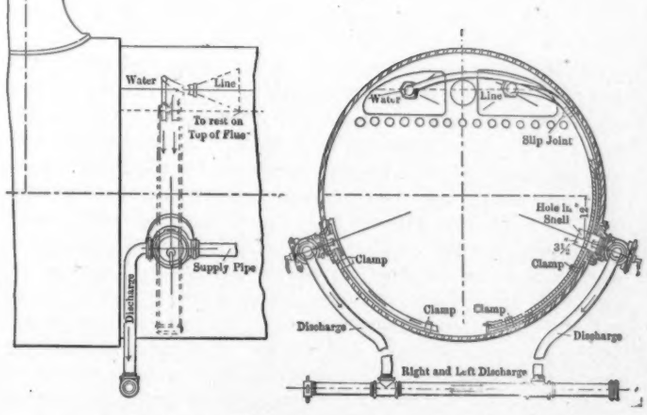
The second engraving shows the method of attachment to the boiler. The two combination valves are applied to their flanges, and they open into flattened 4-inch tubes bent to conform to the shape of the boiler shell. The tube at the left is short and closed at the top. It deposits the feed at the bottom of the boiler and when blowing off takes the water from the same place. The other tube opens above the check into a pair of skimmers and the bottom end is fitted with a hinged valve. This tube deposits feed water at the bottom of the boiler and takes surface water when used in blowing off.

This little device offers several advantages over present practice, and in its service on a number of engines on the worst water district of the Chicago & Northwestern it has more than



Combined Blow-off Cock and Boiler Check.

Designed and Patented by Mr. William McIntosh.



Arrangement of Checks and Blow-off Pipes in the Boiler.

fulfilled expectations. The boiler check is protected from external injury. The supplemental check in the casing takes the place of the usual swinging or globe check in the feed pipe and also takes the place of the check placed near the injector. The combination of the blow-off cock and check valve saves boiler fittings and it has the important advantage of carrying the boiler water in both directions through the main check valve, which keeps it free from scale. The piping leading from the check valves inside the boiler deposits the feed water most favorably for promoting circulation and for preventing the adherance of scale to the heating surfaces, as well as avoiding the straining of the boiler, which is often caused by introducing the feed water against the heating surfaces.

"The advantages of the use of gas engines can be best appreciated," says Mr. George Westinghouse in a recent pamphlet entitled "Westinghouse Gas Engines," "when it is understood that if a gas company were to supplant the present gas illumination by an equal amount of electric light, obtained from gas engines and dynamos driven by its gas, it would have left for sale, for other purposes, over 60 per cent. of its present gas output."

The White Star Liner "Oceanic," which has recently come to New York on her maiden trip, marks an epoch in shipbuilding. This vessel is gigantic and yet so well proportioned that no impression of clumsiness is given. This ship is more than 50 per cent. larger in tonnage than the "Kaiser Wilhelm der Grosse," and we are now told that the "Cymric," now being built at Belfast, is even larger than the "Oceanic." The latter vessel was described in our issue of July, 1897. Her tonnage is stated to be 31,590, as against 20,000 for the "Kaiser Wilhelm der Grosse."

The leakage of steam from the steam pipes of various kinds of plants using ordinary amounts of piping is probably much greater than is generally believed. Mr. R. S. Hale, in "The Engineering Magazine," states that he has found the following proportions of steam to be lost in this way when exposed by tests:

Mills	5 to 16 per cent.
Electric plants	2½ to 7 per cent.
Steamships	1½ to 10 per cent.
Waterworks	2½ per cent.

The proportion of loss depends upon whether the plant is worked up to its full capacity. If the electric plant with a loss of 7 per cent. is working at one-third of its capacity the loss is 21 per cent. of the steam actually used.

(Established 1832)

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY

BY

R. M. VAN ARSDALE,

J. S. BONSALL, Business Manager.

MORSE BUILDING.....NEW YORK

G. M. BASFORD, Editor.

OCTOBER, 1899.

Subscription.—$2.00 *a year for the United States and Canada;* $2.50 *a year to Foreign Countries embraced in the Universal Postal Union.*

Remit by Express Money Order, Draft or Post-Office Order.

Subscriptions for this paper will be received and copies kept for sale by the Post Office News Co., 217 Dearborn Street, Chicago, Ill.

EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

To Subscribers.—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

The paper may be obtained and subscriptions for it sent to the following agencies: **Chicago,** *Post Office News Co., 217 Dearborn Street.* **London, Eng.,** *Sampson Low, Marston & Co., Limited St. Dunstan's House, Fetter Lane, E. C.*

The facts in the case of the introduction of Westinghouse brakes into Russia on a large scale have been published in this journal, and we now have a copy of the order issued by the Minister of Ways and Communication which was transmitted by Consul-General Holloway of St. Petersburg. The order states explicitly that this brake is to be applied to the locomotives and freight cars of the system of 5-foot gauge railroads of Russia, including both the government and private lines, the Transcaucassian Railroad and the roads in European Russia. The private lines may order the brakes directly from the manufacturers or they may secure them through the official channels; contracts made by the roads, however, must come before the Minister of Ways and Communication. It is made plain enough that the whole question of brakes is being handled officially. Provisions are made for careful instruction of train and engine men by the use of air brake instruction cars, and the order throughout gives the impression that the Russian railroad authorities do not intend to leave anything undone to insure satisfactory braking appliances.

Train resistance formulae have formed one of the most elusive subjects of investigation connected with the operation of railroads, and a great deal of excellent scientific work has been done in this direction, some of which dates back to 1829. Clark's formula has been proven over and over again to give incorrect results when applied to present conditions, and as the investigations go on the resistance of trains seems to diminish, as every new formula seems to indicate that previous ones were too high. Some of the formulae are as follows:

D. K. Clarke $R = 8 + \frac{V^2}{171}$

Engineering News $R = \frac{V}{4} + 2$

Baldwin Locomotive Works $R = \frac{V}{6} + 3$

P. H. Dudley $R = 1 + V \div 8$

The last mentioned formula is printed in a recent issue of the "Railroad Gazette," and was obtained from a large number of indicator cards taken at different speeds on a heavy freight engine hauling a heavy train on the New York Central between West Albany and De Witt. Each investigator gets up a new formula, and Mr. Dudley believes it necessary to use different constants for varying conditions of tracks and train weights. It may and probably will be necessary to use a great many constants, because those who know most about this subject believe that train resistance varies with every journal box. The more this subject is pursued the clearer becomes the fact that one exceedingly important factor is usually neglected. This is the acceleration or retardation of trains. There is no way to secure reliable data on train resistance which does not include these items, and it seems probable that one reason for the diversity of opinions arises from the variation of speed, which is the most difficult factor of all to provide for in the calculations.

The relative merits of the locomotive testing plant and road tests for securing reliable information in testing locomotives form an interesting and fruitful topic for discussion. It was introduced at the September meeting of the New York Railroad Club by Mr. R. P. C. Sanderson in a paper describing an elaborate series of road tests involving compound locomotives and valves of the piston and ordinary balanced types. There are advantages in both methods of testing and a careful estimate of the possibilities of both must lead to the conclusion that each has advantages not possessed by the other. Some will not see any good in road tests, because the uncontrollable conditions make it impossible to know what the results mean. Others will not have testing plant tests because the locomotive when run on rollers does not act as it does on the road. As road tests are usually conducted, under a species of excitement and with the interests, either professional or pecuniary, of certain individuals at stake and a view of securing data in the shortest possible time, the conditions are generally such as to render the results of very little value, because of the very great influence of the "personal equation." The fireman may, and usually does, influence the results of road tests more than any ordinary change the value of which is sought for in the tests. We have enough data at hand at this time to establish this statement. The conditions are likely to vary to such an extent with hurried road tests that there is no telling what the figures really indicate, and conclusions based upon them may generally be suspected. This is rather hard on road tests, but it does not mean that the idea of road tests is all wrong. It means that they should be extended over a length of time sufficient to overcome the influence of variables, and the effects of the prejudices of the men handling the engines, whether these are favorable or unfavorable. Variables may be controlled to a great extent in laboratory tests and the testing plant should unquestionably be used for work requiring the separation of factors, for example, in the comparison of different forms of arrange-

ments of exhaust nozzles and draft appliances. In such work the boiler conditions must be uniform and the speed must be controllable. It was possible to accomplish this in the tests of the Master Mechanics' Association committee on exhaust appliances in 1896 by the use of oil fuel on the testing plant whereby the conditions of boiler operation were kept constant and the speed was controlled by a centrifugal governor. It is obvious that road tests on such subjects would be valueless. The final settlement of many important questions must be had on the road, but those in which a slight change in one of several conditions which are constantly changing on the road will effect the results, should be submitted to the testing plant. Both the stationary testing plant and the dynamometer car are necessary, and each fulfills conditions that the other does not. Generally both will be needed in solving a problem in locomotive operation.

HIGH PRESSURE AND DRY STEAM.

The most favorable steam pressures for locomotives seem by many to be considered as settled at about present limits, and in recent discussions involving this subject it is made apparent that considerable comfort is being taken from this supposed fact.

It is generally believed that simple locomotives should not carry pressure higher than 190 lbs., and that 200 lbs. is most favorable for compounds. It has never been clearly demonstrated that either of these limits are correct, and the problem of pressures is unquestionably important enough to warrant specially careful investigation, in view of the great advances in economy which have been made in this direction in marine practice.

It is generally understood that higher pressures permit of improvement in economy at the engines and that this is the cause of the greatest improvement of modern steam engineering. It is not so well understood, however, that a great advantage may be gained by increasing the boiler pressure without increasing the pressure of the engines, and yet this is probably one of the most effective of recent improvements in marine work which has accompanied the rise of pressures in the engines.

By this is meant that there is a great deal to be gained by carrying a very high boiler pressure, which is reduced to a proper working pressure at the engines. The worst enemy of fuel economy is wet steam, and this reduction of pressure, which is accomplished without doing work, is an effective and inexpensive method of drying the steam before it goes to the cylinders. If the steam is dry when it leaves the boiler, it will be superheated by this process, and every one knows the desirability of superheating. The explanation for the superheating effect is simply that when steam passes through a throttled passage in a pipe and reduces its pressure, its pressure changes without a corresponding change in temperature, and it is therefore hotter after throttling than the pressure of the steam calls for in the tables of the properties of saturated steam. This excess temperature may disappear by evaporating moisture in the steam, drying the steam, or it may remain and the steam pass on into the engines in a superheated condition. This is advantageous because the cylinder is a powerful refrigerator and the entering steam needs all the heat it can carry, in order to remain dry as long as possible.

The British Admiralty believe that pressures in marine work will go higher yet. Pressures of 250 pounds and more are successfully used in marine engines, and when steam is furnished by Belleville boilers it is at a pressure of 300 pounds, this reduction at the engines being for the purpose of securing dry steam, as explained.

Dry steam will do more work than wet steam, and the locomotive is noted for using wet steam. The question raised here is whether there is not enough advantage to be had from dry steam at the cylinders to more than offset the additional weight that would be required in the boiler in order to carry the higher pressures. This is one way to attain an increase in boiler capacity which is generally desirable, and the effect on the economy of working may be very easily ascertained. All that is necessary is the building of one locomotive boiler for a working pressure of say 250 pounds and a reducing value in the steam pipe, to throttle the pressure to a proper working point at the cylinders. It would cost so little to investigate the merits of this question as to cause surprise that some enterprising motive power officer does not take it under consideration. We would like to emphasize what has in effect been already said: That this idea may possibly prove to be a good method for increasing boiler capacities.

COKE BURNING ON LOCOMOTIVES.

Coke as locomotive fuel is given considerable space in another column in this issue because of the important and new conditions which have arisen in New England whereby this fuel has already taken an important place in the operation of the railroads of that section. The new development of the manufacture of gas and coke from Dominion coal and the introduction of the byproduct coke oven render a good quality of coke available in considerable quantities, and the introduction of cheaper gas is likely to still further extend the employment of both coke and gas. In the new plant of the New England Gas & Coke Company the by-product and labor saving ideas are so well carried out as to raise the question whether coke or gas is the real by-product. This is chiefly a matter of price, but there seems to be good reason to believe that coke enough will be produced to supply the passenger and probably many of the freight locomotives of the New England roads when the facilities at present in sight are fully developed. It has so far been demonstrated that this coke may be burned successfully on locomotives without expensive preparations of the grates or fireboxes and that this fuel has several important advantages over coal. It is also, speaking conservatively, no more expensive than coal at the present prices, and, weight for weight, it seems to be fully equivalent to the coals most favorable for use in that section of the country.

If sufficient boiler capacity is provided there seems to be no difficulty in burning coke in either stationary or locomotive practice, but there appear to be some peculiarities in the burning of this fuel which render it advisable that the proportions of fireboxes and the provision of air openings should be most favorable to the fuel. Probably about two-thirds as much coke as coal may be burned per square foot of grate area per hour and the openings through the grates for the admission of air need to be somewhat larger for coke. This view seems to be supported by the fact that on the Boston & Maine it is found desirable to run with the fire door open on the latches. Coke consists chiefly of carbon and it is stated that while coal requires from 18 to 20 pounds of air, coke requires about 28 pounds per pound of fuel. The most favorable part of the heating surface for coke appears to be that of the fire-box, and if the promised large development of the coke producing industry is attained it will be important to ascertain the relative values of the different parts of the heating surfaces, such as the tubes and the firebox because of the effect of this knowledge on the design of locomotive boilers in which this fuel is used.

In looking up the subject of coke burning on locomotives all available information has been secured and it all points in one direction. It is a good fuel and its use depends upon the price and the supply. It has been used for some years on the Baltimore & Ohio and is now in use on the Fitchburg and the Boston & Albany, the reports all being favorable. It is not to be expected that coke will be generally used throughout the United States because it will be impossible to secure enough of it. It is probable, however, that what has been done in Boston will be done elsewhere.

PERSONALS.

Mr. E. B. Ashley has been appointed Chief Engineer of the Lehigh Valley.

Mr. J. B. Laurie has been appointed Purchasing Agent of the Central Vermont, to succeed Mr. W. B. Hatch.

Mr. Samuel Potts has been appointed Master Mechanic of the Los Angeles & Redondo, to succeed Mr. W. N. Best.

Mr. P. H. Irwin has been appointed Assistant Chief Engineer of the Baltimore & Ohio, with headquarters at Baltimore.

Mr. J. M. Ward has been appointed Master Mechanic of the Galveston, Houston & Northern, with headquarters at Houston, Tex.

Mr. J. E. Capps, foreman of Car Repairs of the Georgia Southern & Florida, has been given the title of Master Car Builder.

Mr. L. B. Rhodes, Foreman of Machine Shops of the Georgia Southern & Florida, has been given the title of Master Mechanic.

Mr. C. M. St. Clair has been appointed Master Mechanic of the Chattanooga Southern, to succeed Mr. H. T. Ellison, resigned.

Mr. R. L. Stewart has been appointed Master Mechanic of the El Paso & Northeastern, with headquarters at Alamogordo, New Mexico.

Mr. A. Sherwood has been appointed Master Mechanic at Wellington on the Santa Fe. He has been Round House Foreman at that point.

Mr. S. M. Felton has been elected President of the Chicago & Alton, to succeed Mr. E. H. Harriman, who becomes Chairman of the Executive Committee.

Mr. A. G. Leonard has been appointed Purchasing Agent of the Chicago Junction Railway, with office in Chicago, to succeed Mr. F. T. Croxon.

Mr. J. A. Danks has been appointed Master Mechanic of the St. Louis, Kennett & Southern, with office at Kennett, Mo., to succeed Mr. F. Glover.

Mr. John H. Kiesling has been appointed Master Mechanic of the Gulf, Beaumont & Kansas City, with headquarters at Beaumont, Tex., to succeed Mr. F. G. Papineau.

Mr. John Medway has resigned as Master Car Builder of the Swift Refrigerator Car Line. He was formerly Superintendent of Motive Power of the Fitchburg Railroad.

Mr. W. P. Dittoe has been appointed Purchasing Agent of the New York, Chicago & St. Louis, with office at Cleveland, to succeed Mr. M. M. Rodgers, who has resigned.

Mr. J. A. F. Aspinall, General Manager of the Lancashire & Yorkshire Railway, of England, is now in the United States studying the application of electricity to American railroads.

Mr. Lewis Greaven has been appointed Locomotive and Car Superintendent of the Interoceanic Railway of Mexico, with headquarters at Puebla, Mexico, to succeed Mr. H. E. Walker, resigned.

Mr. W. H. Reilly has resigned as Master Mechanic of the Fort Worth & Rio Grande, and Mr. C. H. Burk has been appointed Acting Master Mechanic, with headquarters at Fort Worth, Tex.

Mr. A. C. Hone has been appointed Superintendent of Motive Power and Rolling Stock of the Evansville & Terre Haute, to succeed the late John Torrence. Mr. Hone was Assistant to the Chief Engineer.

Mr. L. B. Heers has been appointed Master Mechanic of the new Pittsburg, Shawmut & Northern Railroad Company, with office at Angelica, N. Y. He has hitherto been Master Mechanic of the Central New York & Western.

Mr. Thomas Burns, Foreman of Locomotive Repairs of the Chicago, St. Paul, Minneapolis & Omaha, at East Saint Paul, Minn., has been appointed Assistant Master Mechanic of that road at Sioux City, Ia., to succeed Mr. J. K. Brassill, resigned.

Mr. W. J. Miller has resigned as Master Mechanic of the Kansas City, Pittsburg & Gulf, at Shreveport, La., to accept the position of Foreman of the shops of the St. Louis Southwestern, at Pine Bluff, Ark., to succeed Mr. Oliver Galbraith, resigned.

Mr. John Hair, Master Mechanic of the Ohio Division of the Baltimore & Ohio Southwestern, at Chillicothe, O., has been appointed Master Mechanic of the Mississippi Division of the same road, with headquarters at Washington, Ind., to succeed Mr. C. E. Walker, resigned.

Mr. W. H. Harrison, formerly Superintendent of Motive Power of the Baltimore & Ohio Lines west of the Ohio River, died of heart failure September 9. He was 68 years old and had served the Baltimore & Ohio 45 years, ending last March, and was one of the best known and most highly respected motive power men in this country.

Mr. John T. Carroll has been appointed Mechanical Engineer of the New York, Chicago & St. Louis R. R., with office at Cleveland, to succeed Mr. Theo. H. Curtis, who recently resigned to take a similar position with the Erie. Mr. Carroll has been connected with the Brooks Locomotive Works for seven years, also with several railroads, among which are the "Rock Island" and the Chicago & Northwestern.

Mr. S. W. Simonds has been appointed general engine-house foreman of the New York Central, with headquarters at Mott Haven. He was formerly a locomotive engineer on the Boston & Maine, afterward general road foreman of engines on the Fitchburg, master mechanic of the last named road, and subsequently held a similar position on the Philadelphia & Reading. His appointment to his present position marks a new departure on the New York Central, of which we shall probably have more to say later.

Mr. Isaac H. Congdon, well known as the inventor of the Congdon brake shoe, and formerly Superintendent of Motive Power of the Union Pacific, died at his home in Omaha, August 21, at the age of 66 years. He was born in Massachusetts in 1833 and began railroad work in 1851 as a machinist on the Cleveland, Columbus & Cincinnati. Afterward he worked as a machinist on the Springfield, Hartford & New Haven, and in 1853 returned to the Cleveland, Columbus & Cincinnati as machine shop foreman. In 1860 he was made Master Mechanic of the Great Western Railway at Springfield, Ill., and in 1866 he went to the Union Pacific as General Master Mechanic. He served in that capacity for 16 years, when he received the title of Superintendent of Motive Power in charge of both the locomotive and car departments. He resigned this position in 1885.

CAR LIGHTING WITH PINTSCH GAS, CITY GAS AND ACETYLENE MIXTURE.

The idea of using cheap gas for car lighting or of mixing acetylene with Pintsch gas to increase its richness, has long been an attractive one to railroad officers, and in response to a request from a well-known superintendent of motive power for information as to the possibilities of reducing the cost of car illumination, we have looked into the subject with a view of presenting the reasons why city gas and mixtures of Pintsch gas and acetylene are not used in this country.

Thirty-nine years ago the Philadelphia & Reading Railroad began to equip railroad passenger cars for lighting by gas. They built compressors and used city gas drawn from the mains in Philadelphia. Afterward a coal gas plant equipped with compressing, storage and delivery apparatus was established at Reading. The latter plant was changed into an oil gas plant, and the advantages of the richer gas, both in the economy of producing the required amount of light per hour, and the multiplied hours' supply, carried in the tanks of the cars, was so apparent that the use of city gas at Philadelphia was discontinued and a Pintsch plant established. The operation of the plant at Reading was then modified to conform with Pintsch practice as regards quality of gas and degree of compression.

The gas now used averages six times the value of compressed city gas. The latter is not manufactured for compressing, and suffers a considerable loss in illuminating power when compressed. Various tests show this to be from 40 per cent. to 60 per cent., the kind of gas, system of manufacture and method of operation all affecting the net result.

One hundred and sixty-seven cu. ft. of Pintsch gas, the universal selling price of which is 85 cents throughout the United States, gives at least as much light as is given by 1,000 cu. ft. of city gas, and to the first cost of the latter must be added the expenses incidental to its compression and delivery to cars. This additional cost averages about $1.25 per thousand cu. ft., making the net cost of 1,000 cu. ft. of city gas in cars about $2.50. For a given amount of light, the less rich in illuminants the gas is, the more the cost of compressing enters into the cost of the light. Six times the cost of compressing must be included in the case of city gas, where the cost enters but once when Pintsch gas is used. Therefore the question arises, how rich a gas can be used and still further reduce this considerable element of cost?

The conditions of gas lighting on railroad cars are different from those generally met with in gas lighting, in this important respect: The entire apparatus is continually subject to jars and chatterings, which detach dust, scale, etc., from the inner surfaces of pipes, tanks and fixtures. The detached particles are carried along by the flow of gas, and if any passage too small for them is encountered, a stoppage occurs. The smallest passage is usually the orifice of the burner, and in the early days of Pintsch practice in the United States, it was necessary to use a tip of the union jet type, having two holes each 0.023 inch diameter. Afterward a change was made to a larger size with holes 0.029 inch and a great improvement was effected. To reduce the size of these orifices below what are now used would therefore be a step in the wrong direction, but this would be necessary if a richer gas were supplied than is now furnished from the Pintsch plants. The question therefore of using a richer gas is disposed of by this practical limitation, and the question of the method of making the richest gas that can be used is one of dollars and cents.

The Pintsch gas supplied in the United States gives from 10 to 12 candles per cu. ft., varying according to the degree of compression and the temperature, either an increase of the former or a decrease of the latter tends to cause a reduction in candle-power.

Acetylene mixed with Pintsch gas is used in Europe, and a great deal has been written on the subject. The practice there is to form a mixture 20 per cent. of which is acetylene and 80 per cent. Pintsch gas. By the addition of this proportion of acetylene the illuminating power of the gas is increased over 100 per cent., but even when so enriched it gives but 8½ candles per foot, the Pintsch gas in Europe being inferior in quality to the product of the American Pintsch gas. Experiments have shown that a mixture of 5 per cent. of acetylene with Pintsch gas made from American oils will combine to make a gas which has a tendency to smoke, even when used in the small-sized Pintsch tips.

CASE HARDENING.*

The process of case hardening has not changed materially for the past few years. The principal materials used remain the same: Granulated rawbone, hydro-carbonated bone black, black oxide of magnesia, sal soda, charcoal and salt. These materials are commonly used in railroad shops and give much satisfaction if they are carefully and properly handled.

For pins and bushings, and such light work as is required for immediate use, we use the "New York Specialty case-hardening powder;" this we found to be greatly superior to pot-ash.

The work which is to be hardened can be packed in cast or wrought iron boxes, sealing with fire clay or mud, so as to prevent the gases from escaping as much as possible. The pieces to be hardened should be placed about two inches apart in the box. The vacant spaces are well filled and packed with the material you are using for case-hardening purposes. Should your box be supplied with heavy work, as crank pins, guides, etc., 15 to 20 hours of steady heat is necessary in order to secure best results. If, on the other hand, you have light pieces, as links, link blocks and pins, 8 to 10 hours will be sufficient to subject them to a good heat.

This class of work we place in the furnace about 8 o'clock in the morning and heat it all day. At night we close up the furnace, letting the box remain over night, and remove next morning. Reheat this work and cool in cold water. We have secured good results using granulated rawbone. If using hydro-carbonated bone black, pack the pieces in a box and seal as before.

Furnaces for case-hardening should be so constructed that the boxes will not have to be raised or lowered while being put into or taken from the furnace. The heating space is near the ground. The firebox and ashpan are below the surface. This refers to a furnace heated with soft coal. If the furnace is outside of a building, a stack or chimney, about 16 feet high, will furnish draft enough to heat the boxes without aid of a blast. Case-hardening furnaces which are heated with fuel oil are of a very different construction, the boxes being generally heated from the top; with coal, in most cases, it is from the bottom. The cooling tub is arranged so as to admit cold water from the end near the bottom, the cold stream thus running lengthwise along the bottom of the tub. This cold stream forces the hot water to flow over the top of the tub.

When cooling guides or long pieces, strips or bars of iron should be laid in the bottom of the tub, in order to keep the work about two or three inches from the bottom of the tub; in this way the cold stream flows under the work which is being cooled.

Soda ash as a preventive of troubles from bad boiler waters received strong praise before the Travelling Engineers' Association from an officer of the mechanical department of the Chicago & Northwestern Railway, who spoke particularly of the effect on the flues in preventing trouble which formerly caused them to leak. The number of flues welded in one shop had decreased from 22,376, in the year 1893, just before the use of soda ash was commenced, to 9,902 in 1898. During this time the mileage per engine had greatly increased.

*Paper read at the Convention of the National Railroad Master Blacksmiths' Association by Mr. John Buckley.

CORRESPONDENCE.

PORT OPENINGS OF LOCOMOTIVE VALVES.

Editor American Engineer:

In the June issue of the American Engineer, Mr. R. A. Smart contributed an article on the subject of this letter, and attributed the reduced area of one of the diagrams published therein to loss of port opening, due to distortion of the valve motion by the friction of the valve.

We must, of course, understand from this that he believes that the friction was greater when the smaller diagram was taken, although he offers no reason why this should be so, but says that the valve was properly and thoroughly lubricated, during the entire test, and also admits that no undue springing of the valve gear was noticeable.

Why should the size, or weight, or friction of the valve, if uniform, produce distortion of the valve motion at one time and not at another, and why should the greater size of the valve in the case mentioned, aside from its increased weight (an inadequate cause for such a result, anyway), add to the friction, if a relatively large area was balanced? If the speed had been higher, when the smaller diagram was taken, we should look for about the same initial pressure, as the increased inertia of the valve, due both to its weight and increased speed, would undoubtedly maintain the full port opening, but for a falling steam line due to the higher piston speed.

Variations in the extent of initial condensation, due to accumulation of water in the cylinders, or to fluctuating fires, falling evaporation, and consequent saturation of the steam, which experience shows, can take place, to some extent, without reduction of boiler pressure, are much more probable causes of such losses than those that Mr. Smart has assigned. A bad steaming engine will not maintain the highest effective pressures in the cylinders, even if the fireman does succeed in holding the full boiler pressure.

W. F. CLEVELAND.

Philadelphia, Pa.

FEED WATER HEATERS FOR LOCOMOTIVES.

Editor American Engineer:

In regard to the question of heating and purifying the feed water for locomotive boilers, discussed in the April issue of your paper, page 116, and in the January issue, it may be of interest to learn how the foreign engineers have handled this problem. Several attempts have been made on the continent during the last three or four decades to heat and purify the feed water by either live steam or that of the exhaust.

The first apparatus designed to accomplish this object was that of Kirchweger, then appeared the injector by Mazza and the pump by Chiazzari, which were fixed on the boiler of an Italian locomotive exhibited in 1878 during the exposition in Paris. This pump heated the feed water to a temperature of 176° to 192° Fahr. by the aid of the steam from the exhaust. After this followed the injectors by Koerting, Manlove, etc., the first of which was combined with a water heating apparatus, and which forced the feed water into the boiler at a temperature of about 190° Fahr.

These different injectors and pumps have been tried by several railroads on the Continent, but chiefly by the Paris-Orleans Railway; while they effected a considerable economy in the total steam consumption, their complicated mechanism, which necessarily required much attention, and the cost of keeping them in repair more than compensated their virtues. Another important drawback to their extensive application was that the exhaust steam, employed to raise the feed water to a certain higher temperature, allowed the oils with which it was impregnated to pass into the boiler.

To overcome this difficulty in using the exhaust steam for heating the feed water Mr. Lencauchez, engineer of the Paris-Orleans Railway, has designed a heater combined with an oil separator so that before the exhaust steam comes into contact with the cold water from the tender it has already been separated from its greasy elements. This form of heater is in actual service on twenty freight locomotives of the above-named road, and which is shown in Figs. 1 and 2.

The exhaust steam, taken from each cylinder by two separated pipe branches, arrives through the pipe, J, into the oil separator, i, passes the toothed end of pipe, J, as seen in Fig. 2, and strikes the bottom, B B, of the oil separator, i; from here, in order to penetrate into the upper portion of the cylinder, i, it has to pass through a very fine grating, K K, composed of a number of scooped-out plates and assembled in such a manner that the steam has to make several up and down courses during which it leaves the oil it contains on the hollowed-out portions of the grating, K K. The steam thus purified passes through, u, into the annular space, Z Z, and thence through the openings, t t t, into the heater proper, where it comes in contact with the cold water.

This cold water is forced into the heater by a pump through the pipe, a, passes through the jet, b, and falls, fountain-like, on the upper vase, d. From here the water tumbles in cascades on the lower discs or vases, d', d'', d''', and passing over its finely toothed edges, it is divided into very small streamlets which facilitates, makes more thorough and rapid the mixture of the cold water with the steam. which, as above stated, arrives through the orifices, t t t. The heated water then fills the bottom reservoir, f, from which by the aid of a hot water pump it is forced into the boiler at a temperature of 192° to 203° Fahr.

It will be seen from Fig. 2 that the orifice, N, is provided with a check valve, O, which the steam opens when it passes into the heater; should the hot water pump fail to work, the excessive supply of cold water in the heater will immediately shut off the communication with the cylinders and thus prevent any water from passing therein; at the same time it will also raise the safety valve, c, as shown in Figs. 1 and 2, and which is loaded to a pressure of 7 lbs. to the square inch, and empty its over-supply through it. The greasy residue, accumulated in the bottom portion, B B, of the oil separator, i, is discharged into the ash pan by opening cock, l, by piping leading thereto; the end of the pipe in the pan is so bent as to prevent any air from passing into the cylinder, i. The heater is also provided with a water gage, as shown in Fig. 1.

The boilers fed by this kind of heater are also provided with injectors which serve when any one of the pumps fails to work.

Another form of heater and water purifier has been lately designed by Mr. Chapsal, engineer of the Western Railway, of France, and adopted on some locomotives on that road. The heater, which is shown in Figs. 3, 4 and 5, is in the form of a dome with internal cones and is located on the boiler. In designing this form of heater and water purifier, Mr. Chapsal desired to realize the following conditions:

1st. The cold water from the tender, on its arrival into the heater, should be subjected to a great reduction of its velocity in order to facilitate the formation of scale to be deposited on the cones.

2d. If the feed water be intermittent, the volume of the heater should be large enough to hold all the water forced in by each single feed in order to utilize the interval of time of two successive feeds in heating the quantity of water of the previous feed.

If, however, the feed be a continuous one, the capacity of the heater should be such that the duration of the passage of the cold feed water over the several cones should be long enough to permit the precipitation of the limestone contained in the water; it will be seen, therefore, that the heating surface of these cones has to be large enough to raise the water rapidly to a temperature at which limestone deposits are formed.

3d. The decomposition, by the heat, of the bicarbonates which form very thin layers of carbonate of lime, should be deposited on very thin plates in order that by their contraction at each feed of cold water the layers of scale just formed may be broken and slid down in the annular space of the heater.

In referring to Fig. 3 it will be seen that the cold feed water from the tender is brought into the heater by two tubes, T, passes over a series of cones, in which steam circulates, and is being heated by virtue of the contact with them. As the arrow lines indicate, the water passes through the holes of the single cones of large diameter and then over the contour of the double cones of a smaller diameter; thus heated to a certain degree, it forms deposits on the thin surfaces of the cones, which, when broken by the contraction of the latter, is accumulated around the bottom edges of the large cones, whose generatrices are made much more inclined than those of the small double cones. The water then passes through a coke filter (which on later designs of the heater has been dispensed with) in the upper portion of the dome and through the tube, T', into the boiler.

This heater was applied to an express locomotive of the

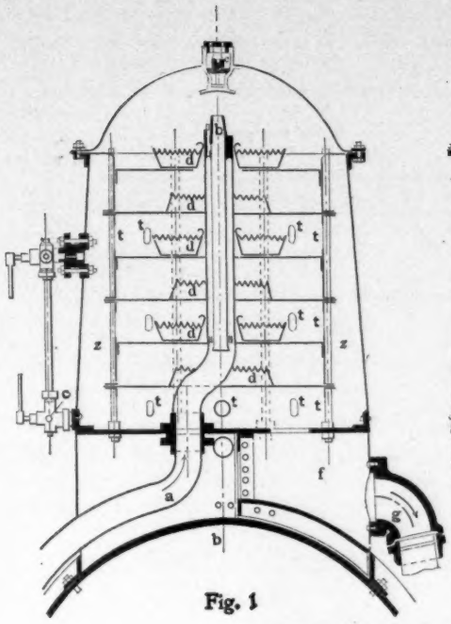


Fig. 1

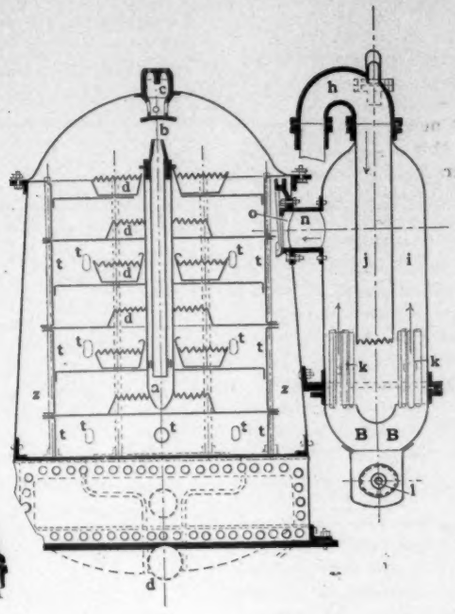


Fig. 2

Feed Water Heater for Locomotives.
Paris-Orleans Railway, France.

Havre line in May, 1890, and it was found that the deposits of laminated tartar, when weighed in a dry state, varied from 22 to 44 lbs. for a running distance of 1,875 to 3,750 miles.

In conclusion I will mention one of the attempts to use electricity as a preventive from boiler incrustation; this is the "electrogene" of d'Hannly, which was frequently tried by different railroad companies on the Continent, but with discouraging results (though the English Admiralty speaks well of it). It is composed simply of a ball of zinc weighing about 40 lbs. suspended in the water space of the boiler by a copper wire from the flues or rivets from firebox. According to the inventor, the zinc and boiler form a galvanic battery, hydrogen deposes on the surface of the plates and prevents the adhesion of the water sediments thereon the deposits are, therefore, easily removed from the boiler by washing out.

If the above will offer some suggestions to those engaged in the solution of the feed water heating problem, I shall be very satisfied in gathering the above information. CHAS. M. MUCHNICK.

Fives-Lille, France, August 30, 1899.

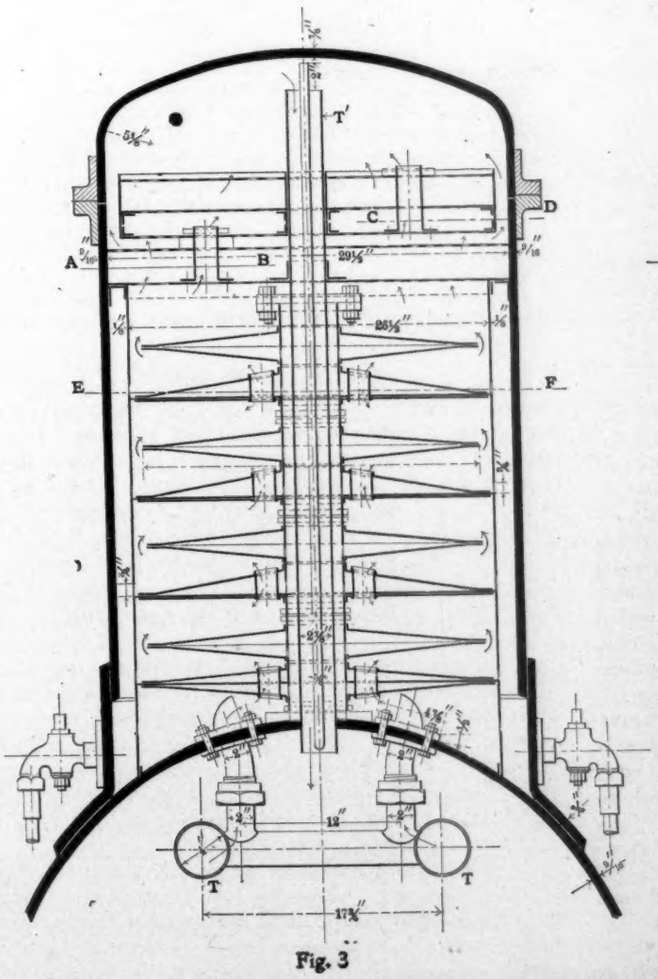


Fig. 3

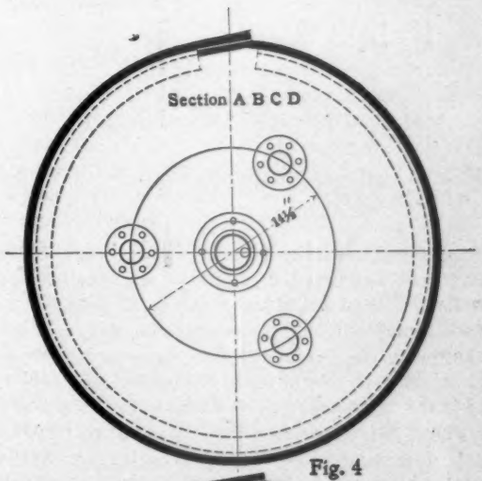


Fig. 4

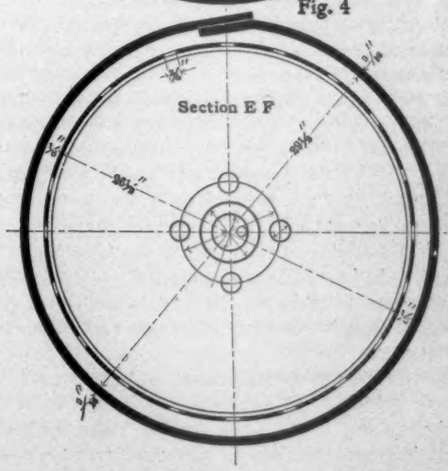
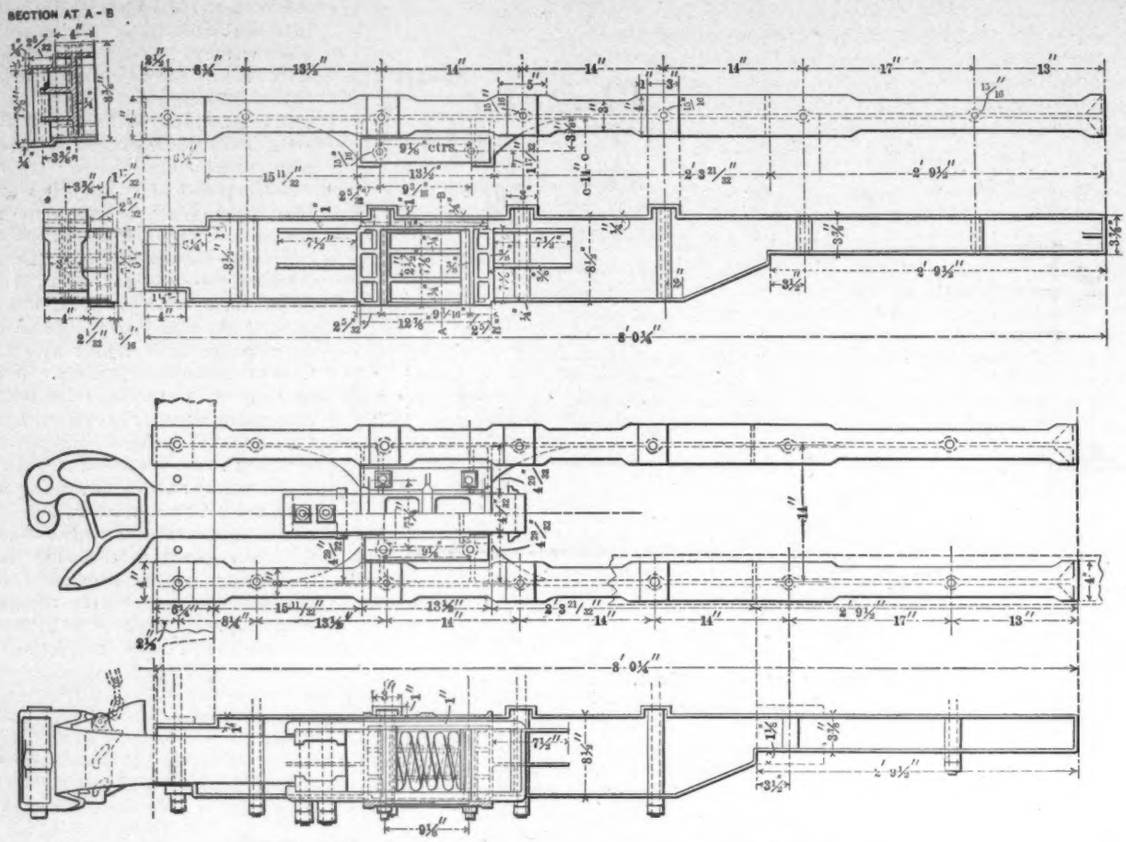


Fig. 5

Feed Water Heater for Locomotives.
Western Railway of France.



Malleable Iron Draft Gear—Southern Pacific Railway.

MALLEABLE IRON DRAFT GEAR.

Southern Pacific Railway.

Mr. J. R. Cade, Master Car Builder of the Southern Pacific, at Houston, Texas, has prepared statistics showing that on that road in 1892 more than one-fifth of the total number of draft timbers were removed from its cars for renewal, and the proportion renewed in the years 1895 and 1896 was 30 per cent. of the number in service. From these figures he considers it safe to conclude that the average life of wooden draft timbers is not more than about 3½ years, and that the average term of service is shortening on account of the increasing severity of the punishment they receive on account of increasing the weight and the loading of cars. From 20,000 to 40,000 pounds have been added to the capacities of cars without a corresponding change in the strength of the draft rigging, and in many cases without any change in this important item. The improvements which have been made have generally taken the direction of increasing the sizes of the timbers, and as there is a limit to the extent to which this may be carried, many car builders are looking to the use of metallic draft beams for the necessary improvement. Mr. Cade directs attention to the fact that if heavy and light cars are to be run in the same trains, fully loaded, it will be necessary to provide the light cars, or those of relatively small capacity, with draft attachments as strong as those for the large ones.

Mr. Cade has sent us a drawing of malleable iron draft beams devised by him, which were put into experimental service in 1893. This rigging has been in use for six years without any repairs, and it has been applied in sufficient numbers to constitute a thorough test of from 2 to 6 years, no repairs on any of the cars having been required in this time. The construction of the beams and their arrangement in the cars is clearly shown in the engravings. Mr. Cade's draft gear uses about 50 less parts than are employed in ordinary draft rigging with wooden timbers, and those who have experience with metal beams believe that they should give longer service than the cars themselves. It has been demonstrated that draft gear needs attention and all improvements in this direction should be encouraged.

ASSOCIATION FOR IMPROVING OUR PATENT SYSTEM.

The need for improvement of the system of protection by patents in the United States has long been appreciated and many efforts have been made in this direction. One of the most promising is a movement started seven years ago in the organization of the American Association of Inventors and Manufacturers, the objects of which are clearly stated in the following quotation from the constitution:

Object.—"The object of this association is to maintain, foster and protect the patent system of the United States, to increase the efficiency of its operation and the stability of patent property.

"To accomplish these results the association aims: To strengthen public opinion favorable to the patent system, by demonstrating the enormous advantages which have been derived by the people of the United States therefrom, in the increase of manufactures and material wealth which has resulted from new machines and methods produced under the stimulus of the legal protection afforded to inventions by the patent system of the United States.

"To procure from Congress legislation authorizing the Patent Office, the only department of the Government which pays all of its expenses out of its income, to spend so much of that income as may be necessary for the scientific, thorough and efficient examination of applications for patents, to the end that patents may be granted only for inventions undoubtedly new, and—

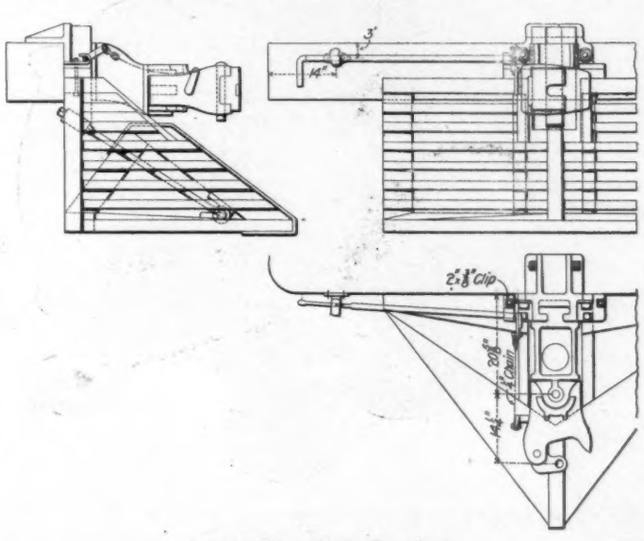
"To strengthen the legal remedies for the protection of such patents as may be issued after a thorough examination."

These worthy objects are in the hands of officers some of whom are well known. The President is Mr. Francis H. Richards of New York. Mr. T. N. Ely of the Pennsylvania Railroad is one of the Vice-Presidents. Among the members of the executive council are Messrs. C. E. Billings, of Hartford; Dr. R. J. Gatling, of New York, and A. A. Pope, of Boston. A meeting of the association is proposed for October of this year. The office of Mr. F. H. Richards, President, is 9 Murray St., New York.

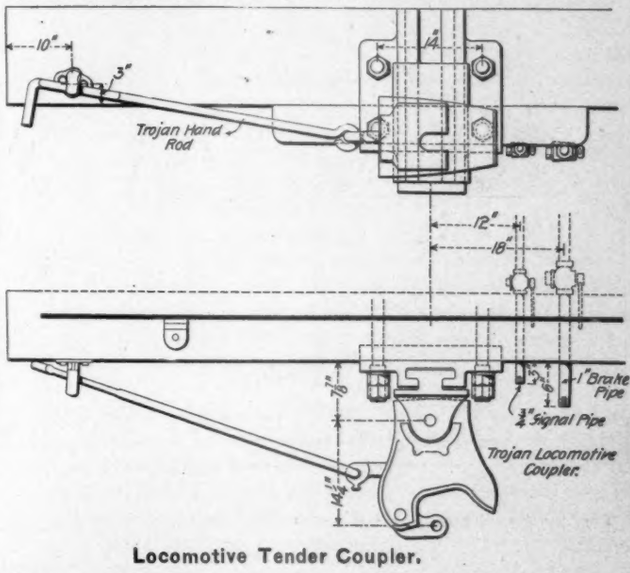
LOCOMOTIVE PILOT AND TENDER COUPLER.

Atchison, Topeka & Santa Fe Railway.

An arrangement of locomotive couplers for pilots and tenders has been devised on the Atchison, Topeka & Santa Fe Railway for the purpose of providing a swing motion to the coupler itself and permitting of vertical adjustment of the coupler without necessitating changes in the attachments which are permanently secured to the pilots and to the rear of



Locomotive Pilot Coupler.



Locomotive Tender Coupler.

Atchison, Topeka & Santa Fe Railway.

the tenders. The plan illustrated employs the same coupler head for both ends of the engine, the head being pivoted so that it will swing through a limited arc either way from the center line on curves, and this pivot is carried in a steel casting, the inner end of which is shaped to fit in a vertical socket, which forms part of the casting attached to the pilot or to the tender. In the case of the pilot socket this casting is made in the form of a bracket, as indicated in the drawing. The bottom of the socket in the supporting casting is closed and the coupler may be varied in height by placing a wooden block of the proper thickness in the socket, the lowest position of the coupler being attained by omitting the block altogether. This arrangement renders it very easy to adjust the height of the coupler, which is done without the use of any tools. The attachment is also easy to replace in case repairs are needed. The parts are all made of cast steel, and from the drawing it is apparent that an adjustment of about six inches in heigh is provided. This arrangement is being applied to all new engines on the Santa Fe lines and it is also substituted in repairs of old engines. Referring to the drawing, it will be seen that the pilot is arranged to clear brake beams, the pilot being 48 inches long.

RAILWAY ACCIDENTS IN 1898.

According to the advance report of the Interstate Commerce Commission, the total number of casualties to persons on account of railway accidents during the year ending June 30, 1898, was 47,741. The aggregate number of persons killed as a result of railway accidents during the year was 6,859, and the number injured was 40,882. Of railway employees, 1,958 were killed and 31,761 were injured during the year covered by this report. With respect to the three general classes of employees, these casualties were divided as follows: Trainmen, 1,141 killed, 15,645 injured; switchmen, flagmen and watchmen, 242 killed, 2,677 injured; other employees, 575 killed, 13,439 injured. The casualties to employees resulting from coupling and uncoupling cars were persons killed, 279; injured, 6,988. The corresponding figures for the preceding year were, killed, 214; injured, 6,283.

The casualties from coupling and uncoupling cars are assigned as follows: Trainmen, killed, 182, injured, 5,290; switchmen, flagmen and watchmen, killed, 90, injured, 1,486; other employees, killed, 7, injured, 212. The casualties resulting from falling from trains and engines are assigned as follows: Trainmen, killed, 356, injured, 2,979; switchmen, flagmen and watchmen, killed, 50, injured, 359; other employees, killed, 67, injured, 521. The casualties to the same three groups of employees caused by collisions and derailments were as follows: Trainmen, killed, 262, injured, 1,367; switchmen, flagmen and watchmen, killed, 13, injured, 69; other employees, killed, 38, injured, 367.

The number of passengers killed during the year was 221 and the number injured was 2,945. Corresponding figures for the previous year were 222 killed and 2,795 injured. In consequence of collisions and derailments 72 passengers were killed and 1,134 passengers were injured during the year embraced by this report. The total number of persons, other than employees and passengers, killed was 4,680; injured, 6,176. These figures include casualties to persons classed as trespassers, of whom 4,063 were killed and 4,749 were injured. The summaries containing the ratio of casualties show that 1 out of every 447 employees was killed and 1 out of every 28 employees was injured. With reference to trainmen—including the term enginemen, firemen, conductors and other trainmen—it is shown that 1 was killed for every 150 employed and 1 was injured for every 11 employed. One passenger was killed for every 2,267,270 carried and 1 injured for every 170,141 carried. Ratios based upon the number of miles traveled, however, show that 60,542,670 passenger-miles were accomplished for each passenger killed and 4,543,270 passenger-miles accomplished for each passenger injured.

For protective coatings for iron and steel the Master Car and Locomotive Painters' Association, in their recent convention, expressed preferences for oxide of iron, graphite and carbon pigment. Pure graphite was considered excellent, but this paint was liable to be adulterated with silica, which, while being a good filler, did not give good wearing qualities.

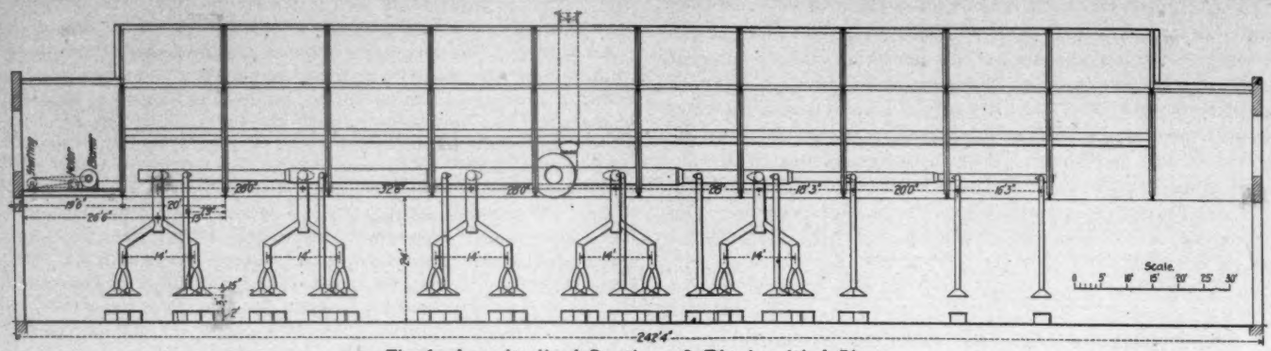


Fig. 1.—Longitudinal Section of Blacksmiths' Shop.
Westinghouse Electric and Manufacturing Co.

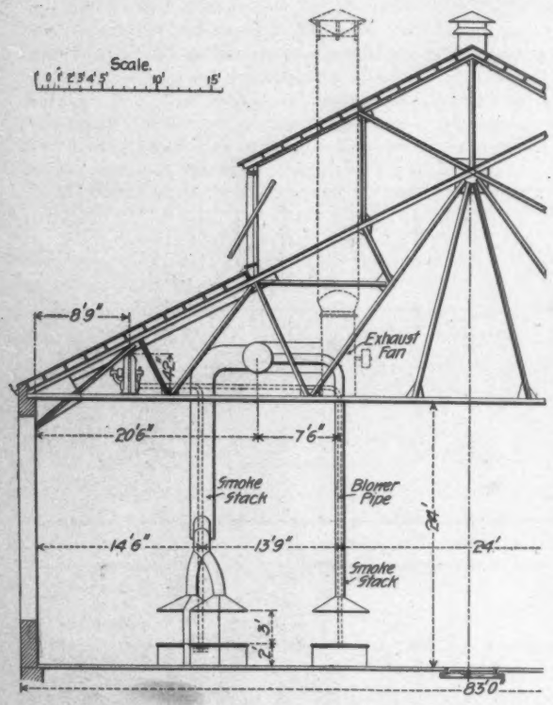


Fig. 2.—Cross-Section of Blacksmiths' Shop.

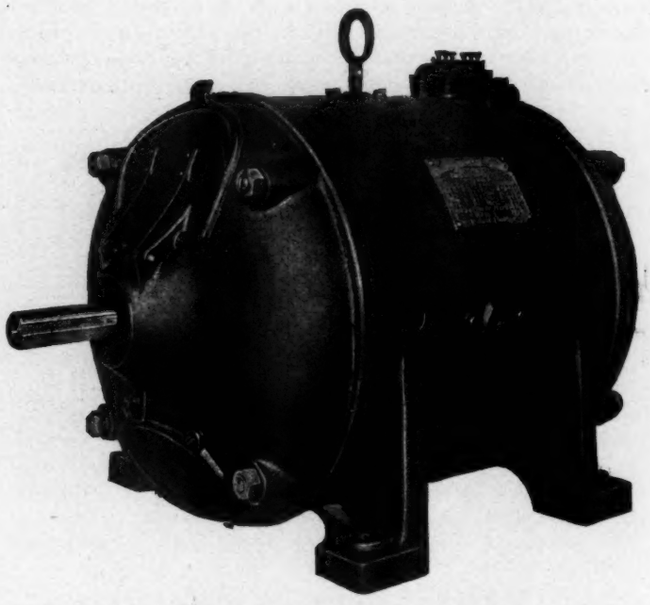


Fig. 4.—Westinghouse Direct-Current Dust Proof Motor.

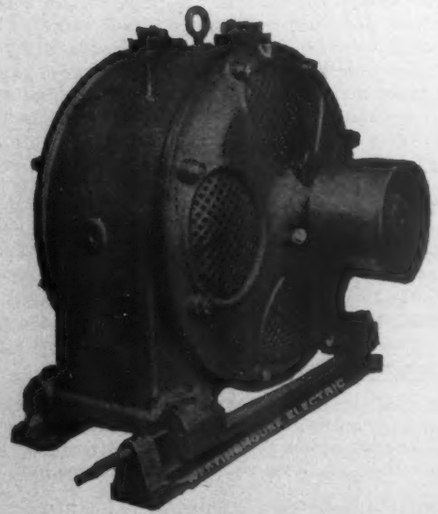


Fig. 3.—Westinghouse Type "C" Induction Motor.

ELECTRIC POWER IN BLACKSMITHS' SHOPS.

In response to a request for a description of a modern blacksmith shop with improved methods of transmitting power, the following article has been prepared with a view of illustrating good methods for application to railroad shops.

The blacksmiths' shop attached to the works of the Westinghouse Electric & Manufacturing Company is operated electrically. It has been so ever since it was erected in 1894. The first consideration in a large smithy is the disposition of the smoke from the forges, and a supply of forced draught for the fires. In the Westinghouse shops these two operations are provided for in a very simple manner. There are two rows of forges on each side of the shops. To provide forced draught a blower driven by a small electric motor is erected to take care of the forges on each side. The blowers and motors are placed in a gallery 24 feet above the floor. These blowers force air through pipes carried horizontally above each line of forges. Connected with this horizontal pipe, vertical pipes 3½ inches in diameter carry the forced draught under the fires of the forges. The amount of draught is regulated by a hand lever at each forge. In order to remove the smoke a hood about four feet square is erected over each forge, three feet above the fire. This hood narrows upward into a six-inch pipe. Four of these pipes are led into a larger vertical pipe, which joins a

horizontal flue leading to the smokestacks. A smokestack is provided for each side of the smithy, in which operate fans, driven by electric motors. By this means there is a continual updraft from each forge, which draws in and carries off the smoke from the fires. The effectiveness of this method is shown by the bright color of the paint upon the roof, which is to-day clean and bright, in spite of the fact that it has not been repainted since the shop was erected in 1894. A longitudinal section of the blacksmiths' shop is shown in Fig. 1, and a cross-section in Fig. 2.

Electricity is also utilized to drive various special tools. An electric motor is placed in the gallery, 24 feet above the floor, which is belted to a line of shafting, to which in turn the tools to be operated are belted. The bulldozer, for bending plates and bars, is one of the special tools operated by electric power. Shears of different sizes are also worked electrically.

In the blacksmiths' shops of the Westinghouse Electric & Manufacturing Co. the hammers are operated by steam, as that power was available, but compressed air may be used. Nearly every railway repair shop, and other large shops, are equipped with air compressors, which serve to operate hammers as successfully as if steam were used. In many works air compressors are driven by electric motors. Electric driving is recognized as standard practice in operating modern blacksmiths' and machine shops. It offers greater flexibility and facilities than can be obtained by any other system. Several railroad companies have put in electrical equipments.

The Atchison, Topeka & Santa Fe Railroad have equipped their Ft. Madison shops, Iowa, with apparatus of the Westinghouse Electric & Manufacturing Company, and have installed generators and motors which operate machines and tools, either by direct connection or by belting to a continuous line of shafting, driven by motors. The electrical current is also used for the railway yards, operating turn-tables for locomotives. The Pennsylvania Company have equipped their Fort Wayne, Indiana, repair shops with electricity. The Westinghouse Electric & Manufacturing Company have installed two 100-kilowatt generators and a number of Westinghouse type "C" motors for operating planing, cutting, punching and other tools. In some cases a type "C" motor is mounted upon a truck on wheels, which can be shifted from one machine to another as required.

The electrical engineer of the Washington Navy Yard has recently fitted up an entire machine shop with shafting worked with Westinghouse electric motors. The building is 250 feet long, the shafting runs the whole length of each side of the building raised 20 feet above the floor. Upon each side the shafting is divided into two sections, an electric motor being bolted to one end of each section, and a fly wheel fixed to the other end to secure better regulation. The two sections may be coupled together in case of need and driven by one motor. The machine tools are belted to pulleys upon the line of shafting. This is a very simple and convenient arrangement for providing power, and occupies no floor space. The Continental Iron Works, Brooklyn, N. Y., have an extensive electrical equipment, and use Westinghouse motors largely in their shops. This firm has a world-wide reputation as the builders of the "Monitor." The Westinghouse type "C" motor is practically automatic, and requires a minimum of attention. See Fig. 3. The revolving parts are enclosed and there is no sparking, which makes it suitable for use in powder factories and wherever explosives and inflammable material is present. The Westinghouse direct current motor, shown in Fig. 4, is made in all sizes, and is adapted to all purposes where wheels have to be revolved or power is required. Both classes of Westinghouse motors are made in all sizes, from ½ horse-power to 500 horse-power.

In our issues of February, March and April, 1898, the electrical distribution of power at the Concord shops of the Boston & Maine R. R. was illustrated. The operation of this plant has been entirely satisfactory and electric power is now being installed at other shops of this road.

THE NEW YORK CENTRAL ANNUAL REPORT, SHOWING THE ADVANTAGE OF INCREASING TRAIN LOADS.

The first report of the New York Central covering a year under the direction of President Callaway, has just been received and it fulfills the expectations of those who have anticipated material improvements in the economy of operation. The entire record is interesting, but we have space for only a few of the operating items. The gross earnings for the year for the system east of Buffalo were $410,417 more than last year, or not quite 9/10 of one per cent. increase, but the net earnings increased 5 per cent. The freight tonnage increased 8½ per cent. and the tonnage carried one mile was 3½ per cent. greater than the previous year. While the rate per ton per mile decreased from 6.1 to 5.9 mills, the freight earnings per train mile were $1.90, as compared with $1.83 for the previous year, a gain of 3.8 per cent. The good showing is due to improvements in operation. The following paragraphs are reprinted from the report:

The decrease of $382,032.63 in the year's expenses does not fully represent the extent of the economy in operation and maintenance. Notwithstanding the increase in the volume of business handled, the expense of conducting transportation decreased $448,155.05.

The introduction of 28 new mogul locomotives ("American Engineer and Railroad Journal," November, 1898, page 362) each capable of hauling 80 loaded 30-ton grain cars (making a gross weight of 3,600 tons for the train and its load), has resulted in a saving of 505,114 train miles, or 3½ per cent. decrease, although the volume of freight traffic was 8½ per cent greater. Twenty additional locomotives of the same type were ordered toward the close of the year.

The average train load for the entire system, including company freight, was 346 tons, as against 320 tons in 1897-8. The average is, of course, much reduced by the large proportion of the mileage of branch and leased lines on which the train load is necessarily small. On the New York Central main line the average train load of through freight, east and west, was 750 tons.

The increase in engine mileage was 372,303 miles, being less than 1 per cent. and little more than one-tenth of the increase of 1898 over 1897.

In handling the freight traffic for the year, 6,025,855 cars were engaged, a decrease of 28,905. The average number of freight cars in main line trains, through and local, east and west, was 49.

The cost of engine repairs per locomotive mile run was 3.47 cents. The cost of freight-car repairs, including $908,550.35 of extraordinary items, was 14.15 cents per train mile. The cost of passenger car repairs per train mile run was 5.01 cents.

The cleaning of passenger cars received an unusual amount of attention at the recent convention of the Master Car and Locomotive Painters' Association in Philadelphia. Frequent cleaning under the direction of a practical painter was advocated because of the saving of paint and varnish and also because of the superiority of the work when done under intelligent and competent direction. Mr. T. J. Rodabaugh of the Pittsburgh, Ft. Wayne & Chicago, spoke very highly of Modoc Liquid Soap for cleaning the inside and outside of cars, stating that cars should not be cleaned with anything that would "kill" or mar the varnish. He did not believe in washing cars every day with water and a coarse brush, especially in warm weather, because if the weather is hot the lustre of the varnish will soon be killed and the car will look flat. He recommended cleaning cars, recently out of the shop, with liquid soap every 30 days, and they should be wiped off after every trip with carefully picked waste.

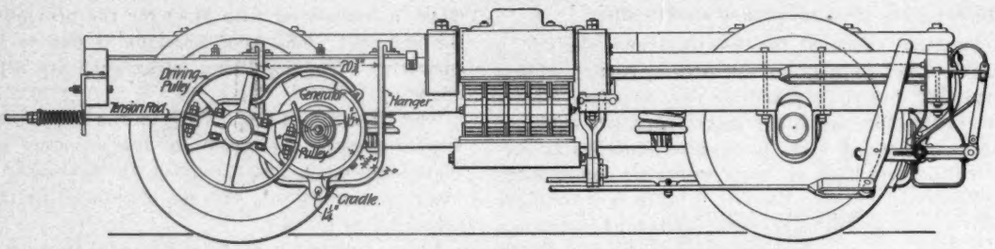
Mr. Frank J. Smith, Foreman of the shops of the Baltimore & Ohio Southwestern at Seymour, Ind., has been appointed Master Mechanic of the Ohio Division of that road, with headquarters at Chillicothe, O., to succeed Mr. John Hair, transferred.

AXLE LIGHTING.

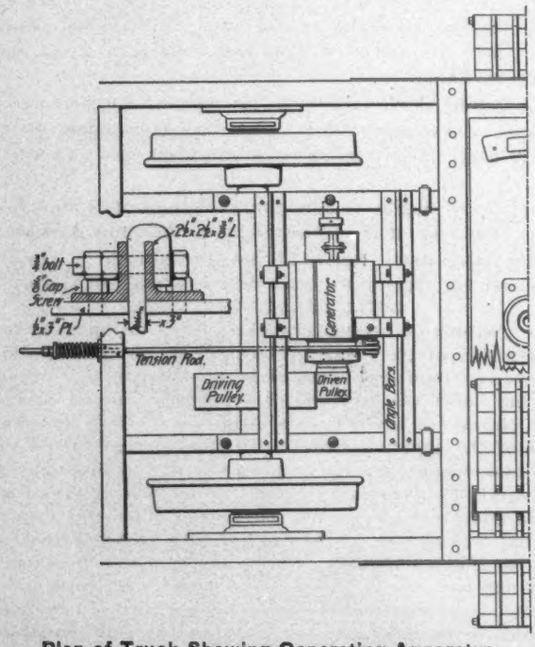
Improvements in Generator Connection and Lubrication.

The system of lighting railroad cars by electric current generated from the axle, which has been developed by the National Electric Car Lighting Company of New York, has made use of a belt connecting the axle to the generator, and while it has proved to be possible to make this work satisfactorily when camel's-hair belts were used, the elimination of the uncertainty of the life of the belt was seen to be desirable, and this company has recently improved and simplified its apparatus by substituting direct frictional contact between a fibre roller on the end of the generator shaft and a pulley mounted on the axle. The belted connection required a countershaft between the pulley and the generator, the triangular connection of which, together with spring mountings in the countershaft bearings, provided for the vertical motion between the generator and the axle. The slack was adjusted by tightening the springs of the countershaft bearings. The average life of a belt with this arrangement was not above 15,000 miles, and the arrangement shown by the accompanying engravings insures a life of at least 35,000 miles for the transmitting pulley, which, we are told, is a statement based on experience.

The engravings illustrate the new method of mounting the generator and the construction of the fibre roller or pulley.



Truck with Generator for Axle Lighting—Atchison, Topeka & Santa Fe Ry.



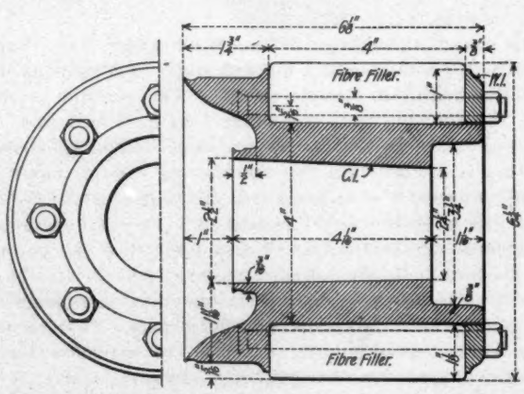
Plan of Truck Showing Generating Apparatus.

The generator is carried under the frame of the truck, to which it is hung in slings and carried on a hinged support at the bottom, as shown in the elevation. A tension rod urged toward the left by a spring draws the roller to the driving pulley with a pressure which is adjustable. It will be seen at a glance that the vertical motions of the generator with reference to the axle are fully provided for in a very simple manner.

In the detail drawing of the driven pulley or roller the method of substituting a new fibre filler for one which may have become worn is seen to be easy. It is stated that this improvement is giving excellent results on the Atchison, Topeka & Santa Fe, where it has been for some time in service. This road has this lighting system in use on about a hundred cars and it is understood that it is to be extended.

In addition to a material reduction in the number of parts the new arrangement renders the generator more accessible and the lubricating problem is greatly simplified. In connection with lubrication another improvement has been made, whereby the oil is carried in a tank containing about 2½ gallons, which is connected to the lubricating devices by a sight feed, and the valve regulating the supply of oil is controlled by a solenoid, which is operated by the electric current in such a way as to cut off the supply of lubricant when the generator stops. By the use of these devices cars make trips of 3,000 miles without requiring any attention to the lubricating apparatus. Experiments are now being made to insure a uniform viscosity of oil in summer and winter. The improved method of driving the generators was designed by Mr. Morris Moskowitz, Chief Electrician of the company, and the improvements in lubrication were devised by Mr. George K. Wheeler, Superintendent of the company.

The Electric Axle Light & Power Company has recently assumed control of the National Electric Car Lighting Company, the new company being incorporated under the laws of New Jersey with an authorized capital of $25,000,000. The introduction of the axle light is to be pushed, and it is understood that the company is also experimenting with a system of car refrigeration, in which the power will be taken from the axles in the same way as it is now taken for electric lighting.



Driven Pulley—Showing Method of Holding the Fibre Filler.

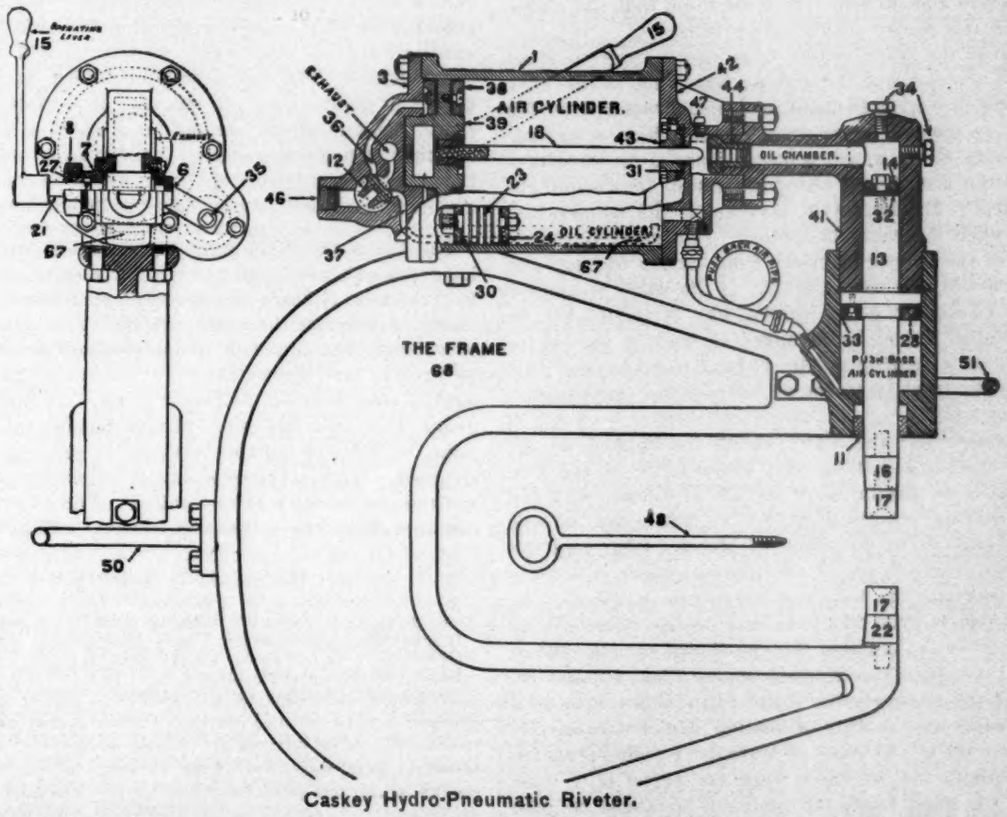
The use of the old Providence station in Boston for trains was discontinued on the morning of September 10, the trains having been transferred to the new South Union Station at that time. There are now but two passenger terminal stations in Boston, and the consolidation of the passenger traffic planned some time ago is now completed. All trains now leave from one of these stations, and the next improvement ought to be a satisfactory way for passing quickly from one of these terminals to the other.

CASKEY PORTABLE HYDRO-PNEUMATIC RIVETER.

The accompanying engraving shows a sectional view of a new form of portable riveter manufactured by Pedrick & Ayer, Philadelphia, Pa., especially intended for ship-yards and structural iron works, and the use of boilermakers and bridge-builders.

The Caskey Portable Hydro-Pneumatic Riveter is designed for using compressed air as a prime mover, with a hydro-carbon fluid used in the oil chambers and oil cylinders. This plan admits of the machine being operated in very cold weather and in open places with no liability of freezing and causing trouble as is sometimes the case with riveters of hydraulic operation, and this is urged as an important feature.

The engraving is largely self-explanatory. The main frame 68, is a steel casting, and may be made in any desired shape adapted to the conditions and positions in which the riveter is to work. The oil chamber and pressure cylinder, 41, is a nickel steel forging accurately machined. The dolly bar or hydraulic piston, 13, is of the best tool steel, accurately machined, hardened and ground. The inside cylinder head, 42, is of cast steel.



Caskey Hydro-Pneumatic Riveter.

This machine is built for very hard usage, and is intended to avoid liability of breakage. There are but four moving parts, and the operating lever, 15, is the only moving part exposed. All packings are easy of examination. The construction of the machine was designed to secure the maximum pressure on a rivet with a minimum weight in the machine. It works rapidly, without shock or jar, is easy to handle and gives a uniform pressure on every rivet. No blow is given when using this machine, and therefore no injury is imposed upon the rivet when being driven.

The riveter is suspended by a bale which allows it to be moved and operated in either a vertical or horizontal position; by changing the bale it can be used sideways with equal facility. Suitable handles are provided on the front and back for the convenience of the operator in placing it over the work. The operating lever is so constructed and connected that the operator may control all movements of the riveter whether standing at the side, back or front of the machine.

No adjustment of the length of the dolly bar, or the rivet dies, 17, is required when riveting on various thicknesses of metal. The dolly bar has a movement of 4½ inches. The first 2¼ inches is known as the rapid movement, which is set down direct by the pressure of 80 pounds from the receiver tank. The last 2¼ inches is the effective movement and develops the maximum pressure, giving a uniform squeeze throughout the entire stroke of the last 2¼ inches, which causes the hot rivet in the hole to be upset, filling the hole.

The pressure is exerted on the dolly bar through the hydro-carbon fluid, which is non-freezing, and so long as the operation valve is open, admitting compressed air to the main piston, the maximum squeeze is maintained on the rivet.

After a rivet is headed, the dolly bar and the die are positively moved back from it by a quick movement of the operating lever. Every detail entering into the construction of the riveter has been studied to make it satisfactory. It is made of the finest quality of materials, with specially designed machine tools and thoroughly tested before leaving the shops of the manufacturer. It is built in twenty-one different styles and sizes, for driving rivets from ⅝ inch to 1¼ inches. All machines are proportioned for using compressed air at 80 pounds per square inch, and to exert whatever pressure on rivets is required. Messrs. Manning, Maxwell & Moore, 85, 87, 89 Liberty Street, New York City, are the sole agents and will be pleased to send further information on application.

Wireless telegraphy operated under the personal direction of Signor Marconi will be used by the "New York Herald" for reporting the yacht races for the America's cup off Sandy Hook next month. Signor Marconi is on his way from Liverpool with four assistants. The instruments will be installed on board the Plant Line steamer "Grande Duchesse," and communication will be held between that vessel and a cable ship which will be anchored near the Scotland lightship, from which cables will be carried to the land lines.

WATER FOR HOT LOCOMOTIVE BEARINGS.

It has been generally believed that the practice of running cold water upon heated journals and crank pins of locomotives was injurious to the metal and a practice not to be permitted. A change of opinion is now indicated by the practice of some of the most important roads in providing means for cooling the journals of engines that are used in specially important service, and the opinions expressed before the Travelling Engineers' Association at the recent convention tended to show that less damage resulted by the use of water than would inevitably be caused by the failure to use it. It is, of course, not intended that water should be used except in cases of emergency, but when a heavy train is run on a fast schedule and hauled by a heavy locomotive it is exceedingly important to possess means for getting the train over the division in spite of hot journals. This is specially the case in fast mail service, which involves fines for delayed trains. It may be thought by some that hot journals indicate carelessness, defective judgment or neglect, but while any of these will cause them, there are other causes which it appears to be impossible to understand and prevent. It is for these that the piping of water from the tender should be provided.

In some cases the warm water from the injector is piped to the engine truck boxes, the driving boxes and crank pins, while in others provision is made to use cold water from the tender tank. It does not seem probable that there is any advantage in using warm water, whereas there is an important advantage in the use of cold water because of its greater absorption of heat. The important question is the temperature of the parts when the water is applied. The hotter the bearing the greater the danger of injury from sudden cooling, and this applies particularly to the brass. If the water is applied in time there seems to be no reason why it should not be used. The piping should be arranged in such a way as to permit of cooling a bearing or pin without stopping, and this applies to tender truck journals as well as the engine bearings.

It is important that the water should be applied at the right place. This, in a driving box, seems to be at the side of the bearing at the beginning of the arc of contact with the brass. The bearing creates a suction at this point, as was explained on page 91 of our issue of March, 1898, and the water is carried over the top of the journal, where it is most effective in absorbing the heat and conducting it away. The method of introducing the oil to the driving box illustrated in the article referred to, and also the one shown on page 183 of our issue of June, 1899, as employed on the Class H5 and H6 locomotives of the Pennsylvania Railroad, is believed to be a good one to reduce the liability of heating, and if it is advisable to introduce oil at the sides of journals it seems probable that this is equally true of water when the object is to flood the journal. On some roads the piping is arranged to take the water to the oil cellars. Good results have been obtained in this way.

In the report of the committee on this subject before the Travelling Engineers' Association, Prof. Goss is quoted as follows: "The use of water on bearings will not injure the bearings unless they are very hot before the water is applied; even then the damage should be attributed to the heating rather than to the use of water in cooling. If the water is applied when the bearing first begins to heat, and if used in sufficient quantities to prevent the melting of the babbitt, it is my opinion that no damage whatever results from its use. Whether the water is used hot or cold it is probably more a question of convenience than otherwise. I do not think that cold water is more severe in its effect upon the bearing than hot, and, other things being equal, a similar quantity of cold water would serve the purpose."

It was pointed out in the report that in marine service heavy bearings are often run for 30 days without lubricant of any kind except water, and no bad results were experienced. It is safe enough to consult and follow marine practice in this matter and the best authority on the operation of marine engines says: "There is no great risk to be apprehended from the supply of water to a bearing which is only beginning to warm up, and the engineer should apply the water service and hose promptly to prevent the brasses heating. On the other hand, an overheated bearing must be treated with far more consideration; the sudden application of water in such a case may cause cracks due to unequal contraction."

One of the chief reasons for Mr. Andrew Carnegie's success is the ability to see that in order to be in the front rank of manufacturing it is necessary to make use of every labor-saving improvement. This involves discarding old machinery and replacing it with new, and often comparatively new machinery is superseded while practically as good as new. The "American Machinist" speaks of him as the "champion scrapper" because he retained no machine or method for what it had done, but considered only present or potential energy. Contrasted with this principle is the one of using a machine until absolutely worn out. A representative of this journal recently visited a railroad shop in company with the newly appointed superintendent of motive power of a road, who had become responsible for the shop where he had learned his trade thirty years before. The old lathe upon which he worked at that time was pointed out. It was still in service and taking up space that was greatly needed for a machine adequate for the demands of modern practice. Mr. Carnegie never hesitated to throw away a machine, as scrap, when he could fill its place with one that would pay for doing so by its increased efficiency.

The use of the Wells light for obtaining intense local heating for flanging the door holes of locomotive boilers was noted by Professor Hibbard in his paper on locomotive boilers, recently read before the New York Railroad Club. The flame is exceedingly hot and with portable apparatus the heating may be directed very conveniently. A somewhat similar use of this light is mentioned in the report of the City Engineer of Providence, R. I., for last year, in melting out the lead from the joints of old water mains in order to remove them from the trenches. With an air pressure of 25 pounds per square inch and the consumption of two gallons of oil, a joint in a 24-inch cast-iron main was melted out in about one hour.

BOOKS AND PAMPHLETS.

A Manual of Locomotive Engineering, With an Historical Introduction. By William Frank Pettigrew. London: Charles Griffin & Co., Limited. Philadelphia: J. B. Lippincott Company; 430 pp., 5½x8½ inches.

In taking up a new book a reader is apt first to refer to its preface, where he may expect to find a statement of the author's objects in writing it. In the preface of Mr. Pettigrew's book he says that "in it the locomotive engine is looked at chiefly from the point of view of the designer or locomotive draughtsman, and the scope and treatment have been mainly determined with reference to his needs; * * * and the calculations which it has been necessary to employ are accordingly suited, as far as possible, for every day use in the engineer's drawing office." He says further, "the work is largely based upon experience gained in the drawing office and workshops, under some of the leading locomotive engineers in this country, supplemented by information kindly furnished by the locomotive departments of the various railway companies."

This "scope and treatment" is obvious all through the book, and to describe it in a phrase it might be said that it is more descriptive than explanatory. What is meant by this observation will appear by quoting a definition of "description" and the word "explain." A "description," it is said in the dictionary, is "an enumeration of the essential qualities of a thing or species." To "explain" is "to make plain, manifest or intelligible; to clear of obscurity; to expound." All through the book the enumeration of the essential qualities of things described, predominate over what might be called their exposition, so that most of the chapters read more like specifications than dissertation in the philosophy of locomotive engines.

The general scope of the book will appear from the main

headings of the chapters. These are: Historical Introduction, 1763-1863; Modern Locomotives, Simple; Modern Locomotives, Compound; Primary Considerations in Locomotive Design; Cylinders, Steam Chests and Stuffing Boxes; Pistons, Piston Rods, Crossheads and Slidebars; Connecting and Coupling Rods; Wheels and Axles, Axle Boxes, Horn Blocks and Bearing Springs; Balancing Valve Gear, Slide Valves and Valve Gear Details; Framing, Bogies and Axle Trucks, Radial Axle Boxes; Boilers; Smoke Boxes, Blast Pipes, Firebox Fittings; Boiler Mountings; Tenders; Railway Brakes; Lubrication; Consumption of Fuel, Evaporation and Engine Efficiency; American Locomotives; Continental Locomotives; Repairs, Running, Inspection and Renewals; Specifications; Principal Dimensions of Locomotives; Table of Modern British and Foreign Locomotives; Index.

The heart of a reviewer nearly always warms towards an author who gives his readers a good index. In this instance this requirement of critical form has been complied with. The index is copious and occupies 12 pages.

The book is elaborately illustrated and contains nine folded plates and 285 smaller engravings. These are generally good, although there are some "process" illustrations which are very shaky. Figs. 9 and 202 may be referred to as instances. The reduction in these and other cases has been too great, so that there is not body enough left to the lines. It may be wondered, too, that an author who has "gained his experience in a drawing office" would consent to allow an engraving like Fig. 143 to go into his book without having the sections hatched or cross-lined, which would have added so much to its clearness. These are, however, minor blemishes.

The book contains an immense amount of descriptive matter of the various subjects to which the chapters are devoted. It will be very useful, too, in that many leading dimensions are given which can so readily be referred to. The details described are, of course, nearly all English, as might be expected, but the American student will be very dull who will not avail himself of all the light which English practice will shed on the marvelous art of locomotive construction.

As an illustration of a foreign idea, which, so far as this critic is informed, is unknown, or at least unpracticed here, reference may be made to the rolling rubber packing ring used in vacuum brake cylinders, and described on page 267. The American reader will find all through the book descriptions of the way they do things in England which may not be as good, or may be better than what we do here, but which it will profit any one who is not a conceited mechanical ass to acquaint himself with.

In one respect, though, we should dissent from the author's arrangement of his book. Reference is made to the historical introduction which forms the first chapter. The history of an art is always studied last by a student of it. When a young man or young woman begins to learn to ride a bicycle they never preface their learning by a study of the history and development of that interesting vehicle, but they get, if they can, the latest pattern "wheel" and devote their study to that alone, and have little concern about its history. A boy when he first becomes interested in steam engines gets all the information he can about the latest and best example within his reach, and it is difficult to arouse any interest in him for the historical development of that wonderful mechanism. It has been said that interest in antiquity betokens the departure of youth; and in a measure it seems to mark a decline in the acquisitive faculties. To give a history of an art first, in a treatise on it, seems to be a reversal of the natural order in which we acquire knowledge, and for that reason the historical past ought always be relegated to the end of the book and not given in the beginning.

The book here reviewed is commended to the readers of the American Engineer and others, and every student of locomotive engineering should acquaint himself with its contents.

Universal Directory of Railway Officials, 1899. Compiled from Official Sources by S. Richardson Blundstone, Editor "The Railway Engineer." Subscription price five shillings. After publication, to non-subscribers, ten shillings. London, 1899: The Directory Publishing Co., 8 Catherine Street, Strand. Representative for the United States, E. A. Simmons, 697 Chauncey St., Brooklyn, N. Y.

This is the fifth annual volume of the valuable list of railroad officials, including roads in all parts of the world. It has been enlarged and now contains 56 pages more than last year. The additions consist chiefly in light railways, and these are distributed over a number of countries. The directory section is enlarged by 33 pages and the personal index by a corresponding amount. The information is compiled from official sources and is probably as accurate as possible in the nature of the work. With the opening of further possibilities in the expansion of foreign trade in railroad supplies, the list, giving, as it does, the chief officers of the most important railroads of the world, with their addresses, will be very valuable to many manufacturers in this country as well as to the officers of railroads. In the list the length of each road and the amount of equipment are included. The finding list of officials and the information for each road are printed in type that is easily read. The advertisements, of which there are many, are placed by themselves at the end of the book, except a few which are placed at national divisions of the work. We find the directory of great value in our editorial office, and commend it to others.

Proceedings of the American Railway Master Mechanics' Association. Thirty-second Annual Convention, Held at Old Point Comfort, Va., June 19 to 21, 1899. Edited by the Secretary, Mr. J. W. Taylor.

This volume is uniform in size and binding with those of the past three years, and as these are in the possession of many of our readers, comment is unnecessary except to remark upon the surprising promptness of the appearance of the complete record of the convention, which was received only eleven weeks after the conclusion of the convention. We know of no other organization of this importance that is able to, or at least does, bring out its official record in such a short time. The deliberations of the association are recorded in condensed form by the technical press during the sessions, but this does not answer the purposes of those who desire to examine the unabridged record for the treatment of important subjects. The Secretary, Mr. J. W. Taylor, is entitled to a great deal of credit for this difficult performance and for the careful editing of the proceedings.

Bullock Electric Power System.—The Bullock Electric Manufacturing Company of Cincinnati, Ohio, have issued a pamphlet, Bulletin No. 2,428, illustrating and describing their method of operating newspaper presses, a large number of which in New York City and elsewhere are driven by their system with the "teaser" method of control. Newspaper press driving requires a most satisfactory power system, and the list of prominent daily papers and other well-known publications printed by aid of this system, as given in this pamphlet, constitutes a most valuable endorsement. In this work the speed must be under positive and accurate control and the power must be absolutely reliable. This bulletin illustrates the attachments of the motors to the presses and by aid of engravings the construction and operation of the motors and controllers are explained. Diagrams show the saving in current which is effected by the "teaser" method of control.

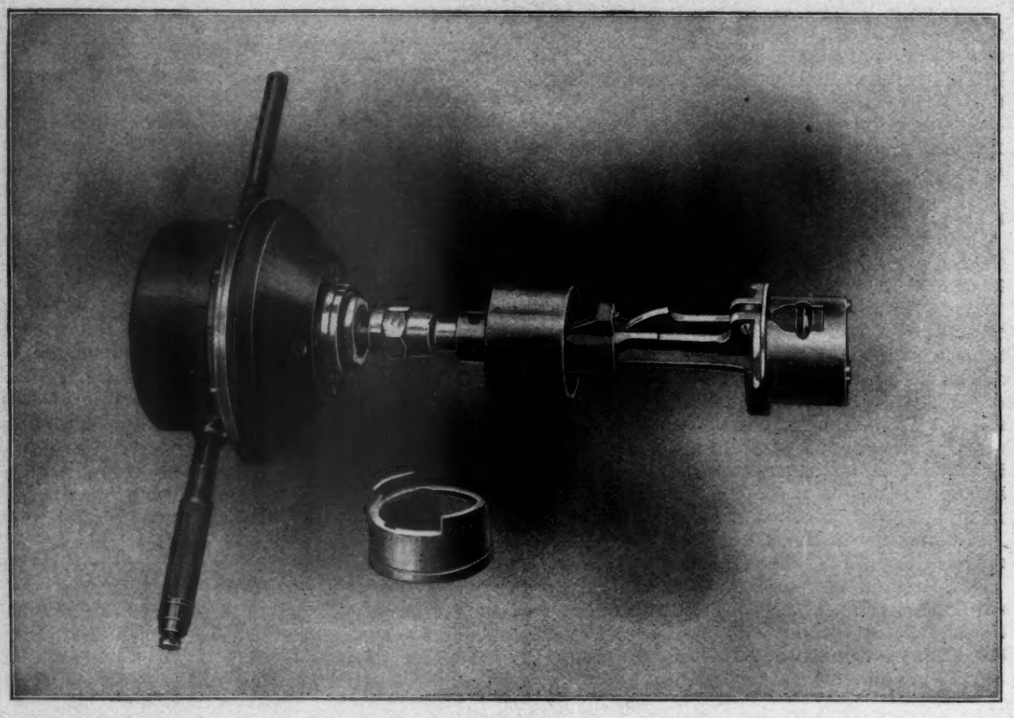
Pratt Institute, Department of Science and Technology.—We have received from Professor A. L. Williston, Director of the Department of Science and Technology at Pratt Institute, Brooklyn, a copy of the annual circular of the department, which describes more fully than previous circulars what the institute is doing in the field of technical education as well as in its evening science and trade classes. The courses offered at Pratt Institute are intended to prepare young men for industrial or business pursuits, and they also tend to develop and cultivate those qualities of mind and character that are of greatest value in any walk of life. The class-room, laboratory and shop training is planned throughout with a view of making the student think and act for himself. The object is to give him "the power to conceive; to plan in detail; and to execute with accuracy"; for these powers are the foundation of all true ability. The primary aim of the courses in steam and machine design and in applied electricity is to furnish as sound and complete a technical and mechanical training as is possible in the limits of two years, and it is intended for those who can not devote the time required to complete a four-year course. It is intended to fit young men for positions as designers of machinery or supervisors of its construction or operation. Pratt Institute does not give as thorough training in two years as may be had from the technical schools with four-year courses, but its plan when carefully studied will be found suggestive for all technical courses wherein there is usually too strong a tendency to teach facts rather than methods of thought.

Dixon's Graphite Productions.—The Joseph Dixon Crucible Co. have recently issued a new general catalogue of the productions of their works. It is standard size, 6 by 9 inches, and has 62 pages with illustrated descriptions of their specialties. The list is too long to give completely here, but our readers are probably most interested in the following subjects: American Graphite Pencils, Axle Grease, Belt Dressing, Brazing Crucibles, Bricks for Furnace Linings, Car Grease, Crucible Clay and Graphite Mixtures, Graphite for Gas Engine Cylinders, Graphite Paint, Gear Grease, Hot-Box Grease, Lubricating Graphite, Lubricating Oil, Pipe Joint Compound and Smoke-Stack Paint. There are so many of these products which are used by our readers that a copy of the pamphlet will be sure to be found convenient and worth sending for.

THE HENRIKSON FLUE CUTTER.

Chicago Pneumatic Tool Company.

The flue cutter illustrated here is newly patented and is known as the Henrikson. The size shown by the engraving is for 4½-inch flues, but the device is also made in smaller sizes, particularly for use in cutting off locomotive flues. It has been adopted generally for flue cutting in the shops of the Chicago & Northwestern Railroad. It is made in any size to meet the requirements of purchasers. Reference to the engraving will show that the flue is cut by a sharpened wheel fed against the flue by means of a cylinder and piston seen at the center of the machine. The air motor revolves the cutter and at the same time the air pressure feeds it to its work. This machine will cut the flues either on the inside or the outside of the flue sheet and it has been found very efficient when used on 4½-inch flues, which are cut off in about 20 seconds. Smaller locomotive flues are cut off in much less time, but we are not told exactly what time is required. Motive power officers will appreciate this device because of its very great advantages over hand work, and it possesses a strong advantage in saving expense in repairing flues because of its ability to cut them off close to the sheet, which effects an important economy of material.



The Henrikson Flue Cutter—The Chicago Pneumatic Tool Co.

Electric Railway Number of Cassier's Magazine.—This is a remarkably fine issue. It contains eighteen articles on different phases of the subject of electric railways, each having been prepared by a recognized authority, and it is an excellent, exceedingly valuable record. It contains 292 pages of reading matter and over 200 engravings.

The Watson-Stillman Co. have issued a new catalogue in accordance with their plan of publishing sectional catalogues subsidary to their illustrated index or catalogue of catalogues. The one before us is an assortment of illustrated sheets grouped under the title "Catalogue No. 54," and covers the subject of hydraulic jacks. It has an introduction or preface and an alphabetical index, and includes additions to former lists of jacks arranged to be uniform with previous lists. Entirely new matter is presented on pages 18 to 26. New tools are shown on pages 34, 35 and 36. On page 51 is an announcement to the effect that the firm will rent jacks for temporary use to those who need them only occasionally, and the prices given are reasonable. The catalogue is indexed and it is also provided with an alphabetical list of the large variety of jacks and presses made by this concern, each device being illustrated upon a separate sheet which may be obtained upon request by giving the number of the one desired. These sheets are used in the sectional catalogues, which are issued as occasion requires. The sectional plan is an admirable one for a firm manufacturing such a large variety of product which is used in nearly all branches of manufacturing. The engravings are uniformly excellent wood cuts which are noteworthy for their clearness.

The Ajax Metal Company has not joined the "Brass Trust" and has no intention of doing so. Reports have been circulated to the effect that they had done so, but we are able to state positively that they are not true. The company is not in any way, shape or manner connected with any brass trust and will not countenance a proposition to join one.

Service stripes are to be worn by the uniformed employees of the Baltimore & Ohio Railroad. A gold stripe will indicate five years of service, and a silver stripe two years. We are informed that some of the conductors are entitled to wear from seven to nine stripes. The company will furnish conductors, brakemen and baggagemen with badges, so that they may be readily distinguished by patrons.

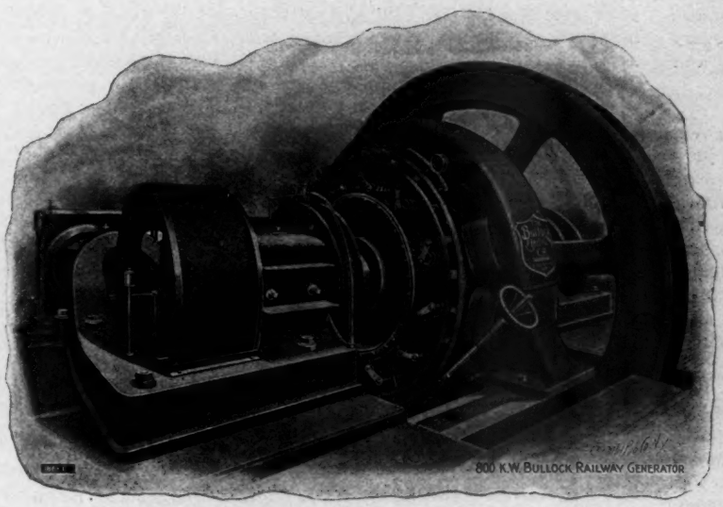
A NEW STREET RAILWAY GENERATOR.

The Bullock Electric Manufacturing Company.

Encouraged by their success of the past ten years in other lines of electrical equipment, this company has now determined to enter the railway field. To this end a complete line of engine type railway generators has been designed up to and including the 800-K. W. unit.

Bullock's railway generators will possess all of the features that have made its present standard machines so popular, and also some new features that cannot be found in other machines.

Among the more important may be mentioned a scheme for oscillating the brush holder mechanism in a direction parallel with the shaft. The movement is very slow and results in constantly changing the line of travel over the commutator face and thus removes all tendency to cut or groove the latter. The action is the same as secured by the end play of an armature in a belted generator or that produced by the electro-magnetic device used at the end of the shaft on rotary transformers, and which is recognized by engineers as a means of greatly prolonging the life of the commutator.



A New Street Railway Generator.
The Bullock Electric Mfg. Co.

The pole pieces and coils may be removed without disturbing the yoke or armature, and with two of them removed it is possible to remove one or more armature coils should repairs be necessary.

The armature coils are made of continuous bars of copper without joints between the commutator connections, which materially adds to the life of the machine. These coils are all thoroughly insulated, pressed and baked before being placed on the core, no additional core insulation being necessary.

All armatures are thoroughly ventilated by slots perpendicular to the shaft through which the air rushes when the machine is in operation.

A liberal rating permits of constant operation at full load with low temperature rise.

One of the 800-K. W. machines has been sold to the Oakland Rapid Transit Company, of Oakland, Cal., and is shown in the engraving. This machine operates at a speed of 80 R. P. M. and at this speed develops 550 volts at no load.

It is over-compounded for a rise of 50 volts at full load, making the full-load voltage 600.

EQUIPMENT AND MANUFACTURING NOTES.

The New York office of the National Electric Car Lighting Co. has been removed to the offices of the Electric Axle Light and Power Co., 100 Broadway.

The shops and yards of the Pittsburgh & Lake Erie at McKees Rocks are to be rebuilt, and a refrigerating plant is to be installed, the cost of the entire improvements being placed at $500,000.

Mr. B. F. Pilson, of Richmond, Va., who has for a number of years represented the Ajax Metal Co. in the South, has been appointed General Contracting Agent of that company. He has been very successful, and this appointment shows the appreciation of his valuable services.

The St. Louis Railway Club has had placed at its disposal a free scholarship in Blees Military Academy, which covers all necessary expenses for a student sent by the club. This is available for the son of a member of the club who shall receive the appointment through the executive committee and pass the necessary examination.

The Ajax Metal Co. have installed an exhibit in "Section M—13, Main Building," of the National Export Exposition, now being held in Philadelphia, to which railroad managers and motive power officers are invited. A representative of the company is in attendance and at the service of visitors. Facilities for correspondence are provided and every attention will be given those who avail themselves of this invitation.

The Joseph Dixon Crucible Co.—"Making Records" is the title of a little pamphlet of 32 pages issued by this concern to exhibit the written opinions of a large number of locomotive engineers who have used graphite for the lubrication of locomotives. The names of the writers are not given, but they are not needed to give force to the reports. Every motive power officer not using graphite should procure and examine this pamphlet. The address of the Joseph Dixon Crucible Co. is Jersey City, N. J.

The Baltimore & Ohio Railroad has recently placed several orders for new freight equipment to meet the excessive demand for cars. The South Baltimore Car Works are building 1,200 Baltimore & Ohio standard box cars. The American Car and Foundry Company has an order for 150 refrigerator cars and 10 improved horse cars have also been ordered. The road has received only 1,000 of the 6,000 Schoen steel cars ordered some time ago, and when the remaining 5,000 are delivered, will have 6,360 cars to add to the 45,000 now in use.

William H. Wood, Hydraulic Engineer, Media, Pa., has received orders to place one of his hydraulic riveting plants in the Coatesville Boiler Works, Coatesville, Pa., and he is putting in two hydraulic riveting plants for the Aultman & Taylor Machinery Co., of Mansfield, O., and one for the Edw. Keeler Co., of Williamsport, Pa. He has also recently started one of his hydraulic riveting plants for Thos. C. Basshor & Co., of Baltimore, Md., one for the Boston Navy Yard, U. S. Government, and a plant for Orr & Sembower, of Reading, Pa.

The new Boyer long stroke hammer, made by the Chicago Pneumatic Tool Co., has made an excellent record at the works of the Pressed Steel Car Co. at Pittsburgh, showing that it may be used by men who are not expert riveters and that the machines may be used for long, continuous work, without failure. One of them was put into use at these works at noon August 21 and was not out of service at all for seven days and nights. It may have run much longer than that, but of this we are not informed. The rivets were ⅞-inch in diameter and, as we understand it, the machine was not stopped and did not break down in this time.

The Bullock Electric Mfg. Co. reports sales for August

amounting to 52 machines, ranging in capacity from 2½ to 300 kilowatts. The orders came from points in widely separated parts of the United States, and two were from Great Britain. The British orders were for "teaser" equipments for driving large printing presses, one 50-H.P. equipment for the "Free Press" of Aberdeen, Scotland, and four 50-H.P. equipments for the "Scotsman" of Edinburgh. The Bullock Electric Mfg. Co. has just issued Bulletin No. 2432, which may be had on request of the general office in Cincinnati, Ohio.

The firm of Dietz, Schumacher & Boye, manufacturers of machine tools at Queen City Ave. and Buck St., Cincinnati, has been dissolved and a new partnership formed under the name of Schumacher & Boye, Mr. Jacob Dietz having retired from the concern. The new firm assumes all indebtedness of the old one and obligations due are payable to the new firm.

The phenomenal rapidity of the introduction of pneumatic tools has been remarked in these columns. The statement is now made by the Chicago Pneumatic Tool Co. that their sales for August last were greater than for the entire year 1897. This is probably due to the increasing number of these tools required by those who have used a few and found the possibilities of reducing costs to demand increasing the pneumatic equipment. The sales of this company have increased every month since the introduction of the pneumatic devices, and they are now considered indispensable as labor savers.

The New York office of Valentine & Company, the well-known varnish and color manufacturers, recently reported the purchase of additional property adjoining their Brooklyn works, and the filing of plans with the Building Department for a large two-story building thereon. We now learn that even this extension will not suffice for the needs of their business, and that they have just filed plans for the erection at their Chicago works of a large three-story building; the ground floor to be devoted to tanks and the storage of varnish, the other two floors to contain machinery and other facilities for the grinding and packing of colors and paints.

The Chicago Pneumatic Tool Co. has installed a comprehensive exhibit of pneumatic tools at the National Export Exposition at Philadelphia, including the new Boyer long stroke hammer for driving rivets of diameters from ¾ to 1¼ inches, the new reversible wood boring machine, the Henrickson flue cutter driven by a reversible motor, the well-known Boyer drills and hammers for clipping and caulking, the Haeseler piston drills, Phoenix rotary drills and other pneumatic appliances. The air supply will be furnished by an electrically driven air compressor. The exhibit is under the charge of a competent attendant, and is intended to furnish practical demonstrations of the value and convenience of these devices to foreigners and others interested in the subject.

The Baltimore & Ohio Railroad has ordered thirty four-cylinder compound consolidation freight locomotives from the Baldwin Locomotive Works, for December and January delivery. The cylinders are to be 15 inches and 25 inches in diameter by 30 inches stroke. The total weight of the engine, exclusive of tender, is to be 176,000 pounds. The drivers are 54 inches in diameter with a driving wheel base of 15 feet 4 inches, and total wheel base of 23 feet 8 inches. The tenders will have 5,000 gallons water capacity, 8 tons coal capacity, and weigh 95,000 pounds. The boilers are to be of the extended wagon top type, 64 inches in diameter at the front end. The firebox is to be 41 inches wide and 118 inches long. When these locomotives are completed the Baltimore & Ohio Railroad will have 137 freight engines, each exceeding 175,000 pounds in weight.

The H. K. Porter Co., builders of light locomotives, are now engaged upon an order for three steel works locomotives for the Newburgh, Ohio, works of the American Steel & Wire Co.; also on an order of five contractors' locomotives for Messrs. Nawn & Brock, of Boston, for use on a large water-works contract in Brighton. They are also building a little engine for 18 inch gauge, having cylinders 6 by 10 inches, for the French Rand Gold Mining Co. of Johannesburg, South Africa, and they have just shipped a 7 by 12 inch locomotive for 30 inch gauge to Japan. A 7 by 12 inch compressed air locomotive for 21 inch gauge has just been shipped to the Commonwealth Iron Co. for work at their mines at Norway, Michigan. This firm is also reaching foreign trade. A 11 by 14 inch consolidation locomotive has recently been shipped to Russia to run on track with a gauge of 29½ inches.

The Russell Snow Plow Co., Room 751 Tremont Building, Boston, has received a large number of orders, of which the following is a list: Long Island Railroad, one Russell standard double track plow, size No. 2; New York, New Haven & Hartford Railroad, one Russell standard single track plow, size No. 2, to be equipped with Russell air flanger (double) and Westinghouse air brakes; Rutland Railroad, one Russell wing-elevator snow plow, size No. 2; Fitchburg Railroad, two Russell standard double track plows, size No. 2, to be equipped with Russell air flangers, Westinghouse brakes and Westinghouse train air signal apparatus; Boston & Albany Railroad, one Russell standard double track plow, size No. 3, to be equipped with Russell air flanger and Westinghouse air brakes; Copper Range Railroad, one Russell wing-elevator plow, size No. 1, Special, to be equipped with Russell air flanger, Westinghouse air brakes and Westinghouse train air signal apparatus; Lake Shore & Michigan Southern Railroad, one Russell standard double track plow, size No. 4, to be equipped with Russell air flanger, Westinghouse air brakes, Westinghouse train air signal apparatus and Gould automatic couplers; Philadelphia & Reading, two Russell standard double track plows, size No. 2, to be equipped with Westinghouse air brakes, Westinghouse train air signal apparatus and Gould automatic couplers; and Delaware, Lackawanna & Western Railroad, three Russell standard double track plows, size No. 2, to be equipped with Westinghouse train air signal apparatus.

The Rhode Island Locomotive Works, now operated by the International Power Co., have just received an order for ten 10-wheel freight compounds for the Chicago Great Western, to be built in accordance with the Rhode Island system of compounding, which has been modified and improved without, however, changing the essentials. These engines will have two cylinders, 22 and 35 by 28, and were designed to be equivalent in cylinder power to a 20 by 28 inch simple engine, the boiler pressure being 200 pounds. The driving wheels have cast steel centers and are 63 inches in diameter over the tires. The total weight will be about 160,000 pounds, of which about 120,000 will be on the drivers and about 40,000 on the trucks. The boilers will be of the extended wagon top, radial stayed type, 64 inches in diameter at the smallest ring and having a total heating surface of 2,600 square feet. The grate is 112 by 42 inches, having an area of 32.6 square feet. The driving axle journals are 9 by 12 inches, and these axles and the crank pins are to be of the Coffin process steel. The tenders will have frames of steel channels, and the tanks will carry 6,000 gallons. These works are completing an order for 22 locomotives for the Wabash, 4 of which are compounds. The recent order for 4 heavy freight engines for the "Big Four" has been increased to 10, and in addition to these orders the shops are busy with an order for 21 boilers for the Erie, 16 of which are of the Wootten type and 5 are extended wagon tops. The equipment of the Rhode Island Works has been improved by the addition of a number of new tools, including rod and wheel borers, a large hydraulic wheel press and a set of 16 foot bending rolls. The 12 foot hydraulic riveter formerly in use at the Grant Locomotive Works, has been purchased complete and is now being set up. The flanging work on boilers is all done on the large flanging press that was used before the change in management. The new management of the Rhode Island Locomotive Works includes Mr. Joseph Lithgoe as Superintendent, and a large number of the old foremen and many of the former shop hands have returned. The shops appear to be exceedingly busy and prosperous.

WANTED.

A situation by a foreman boiler maker, acquainted with all modern appliances for economical construction of boilers. Extended experience in locomotive building and railroad shops with both day work and piece work systems. Good references. Address "Energy," care "American Engineer and Railroad Journal," 140 Nassau Street, New York.